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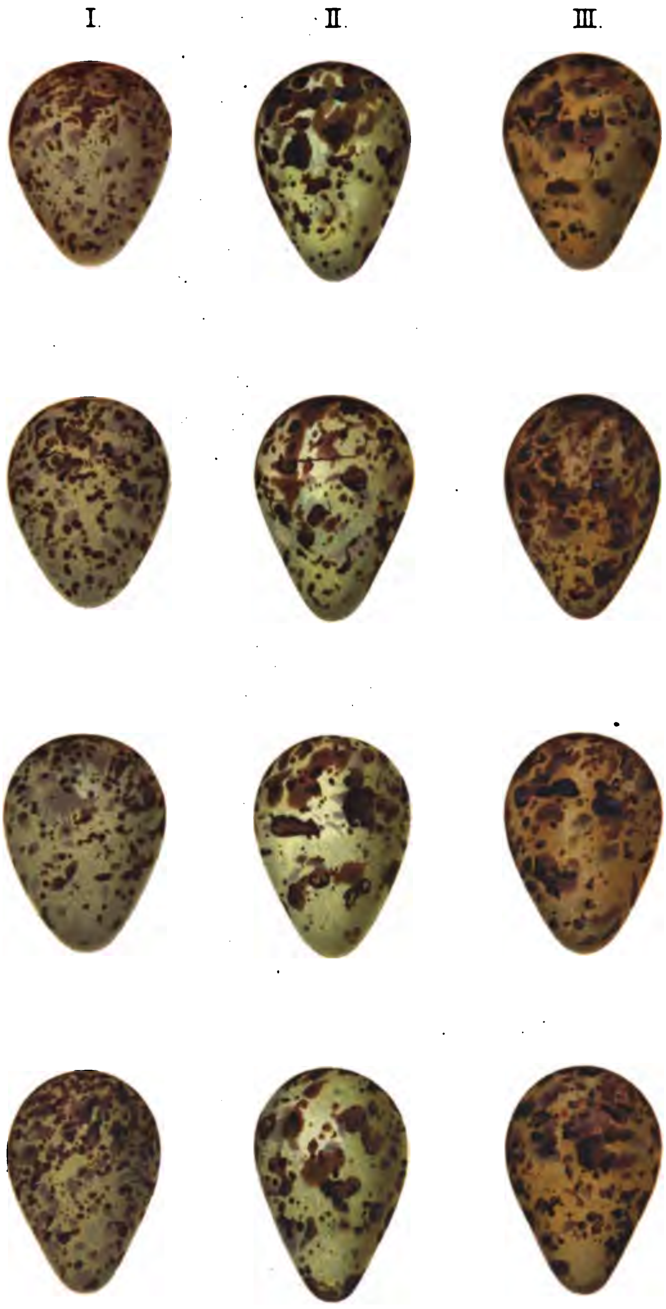

EGGS of LITTLE STINT.
Tringa minuta.

H Grönvold del.
Litho. Wilhelm Greve, Berlin

10

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TWO SUMMER VOYAGES TO

[illegible]

AND THE ISLANDS OF

BARENTS SEA

BY

HENRY J. PEARSON

WITH APPENDICES

ON THE BOTANY AND GEOLOGY

BY

COLONEL H. W. FEILDEN

LONDON
R. H. PORTER
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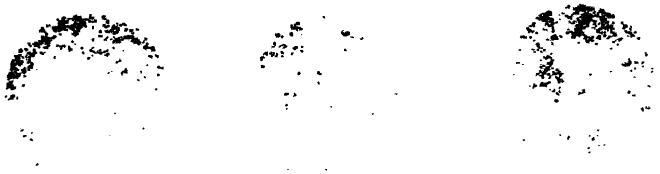

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PREFACE

IN these days, when new books on travel in the Arctic regions appear almost every season, it requires some courage to add yet another to the list. I have done so in order to bring into one volume the papers written by Colonel Feilden and myself in *The Ibis* with those by the former on the Botany and Geology of Novaya Zemlya, Waïgatch, and other countries visited by us in 1895 and 1897, together with some fuller details of the voyages.

With my brother, Mr. Charles Pearson, I had made excursions to the north of Norway in 1891, 1892, and 1893 (accompanied on the last trip by Mr. E. Bidwell) to study the breeding habits of many of our English birds in their northern homes, and we gained thereby much pleasant experience. 1894 was spent in the southern parts of Iceland.

When discussing our plans for 1895, Novaya Zemlya struck us as a country containing much of interest in bird-life. Papers on the ornithology of these islands had already been published by Dr. K. E. von Baer in 1837; by Mr. George Gillett (*Ibis*, 1870); by Dr. Th. von Heuglin (*Ibis*, 1872); by Von Pelzeln on Count Wilczek's expedition in 1872; and by Dr. Hjalmar Théel on the results of the Swedish expedition in 1875. The accounts also by Baron Nordenskiöld, Admiral Markham, and others mentioned that Bewick's Swans and many rare birds nested there, the sight of which would well repay a voyage. There were, besides, questions unresolved by previous explorers which we felt a strong desire to investigate; and Novaya Zemlya was soon decided upon.

Then arose the first difficulty, namely, how to get there, and it proved a serious one. It became clear that we must charter a yacht, and our troubles began in earnest; for I spent four months in constant correspondence with some half-dozen agents in the effort to find a suitable ship. Each agent was furnished with a full description of our requirements, namely, a wooden-built yacht, able to sail freely without steam, and to carry six or eight weeks' coal in her bunkers, &c. In reply to which, offers began to pour in of the most delightful boats, "replete with every luxury" (a piano generally included), made of the thinnest sheet iron, and only fit to be trusted in the Channel on a calm summer day. At the end of those four months only one ship had been offered which could be of service. This was the S.Y. *Saxon*, a yacht well known to us by repute, as Mr. Trevor-Battye and Mr. Mervyn Powys had chartered her the previous year for their voyage to Kolguev and Novaya Zemlya. In many ways she was distinctly unsuitable, her worst points being her deficient sailing power and her small coal capacity. Still, she was built of wood, and she had been there before, which were great recommendations. So the charter was settled and a crew engaged. The first engineer and two other men had made the voyage the previous year, but it was remarkable how little they remembered of where they had been. I also got three old whaler hands from Peterhead, who proved useful men; in fact, the whole crew of nine turned out "a good bargain."

As soon as our plans began to get definite shape, we invited Colonel Feilden and the Rev. H. H. Slater to accompany us; and I need scarcely say that the experience of the former in Arctic work was invaluable, both in the necessary preparations and during the voyage. Mr. Slater also brought much useful botanical and ornithological knowledge to the service of the expedition, and his intimate acquaintance with the notes of birds was often of great assistance. I take this opportunity of expressing my obligations to Colonel Feilden, who has placed his diaries of our voyages at my disposal for the preparation of this book.

It may be complained that the whole thing is far too "birdy," and without doubt birds and their doings occupy the largest portion; but the study of bird-life was the first reason and object of the voyages. Birds also are my excuse for adopting the form of a strict diary; for one of the chief interests connected with the study of their habits during the breeding season is the date at which they complete the various stages from nidification to the appearance of the young birds in full plumage on the wing.

The history of the expedition is told in detail (perhaps too much of it) in the following chapters. I venture to hope that the narrative will be accepted as an accurate account of the various facts connected with the natural history of the regions we visited, and that some useful information may be found by those interested in the subject.

The following names are synonymous :—

Waïgatch	Waigats.
Dolgaja Bay	Dolga Bay.
Belootchia Bay	Beluga Bay, Goose Land.
Belushja Bay	Beluga Bay, Lütke Land.
Meshdoshapek Island	Meshdusharsky Island.

N.B.—Since the following pages went to press I learn that his Excellency the Governor of the province of Archangel has made arrangements whereby the Samoyeds of Novaya Zemlya obtain the full value of all the produce of their hunting, and receive regular supplies of flour and other necessaries at fair market prices.

I would strongly recommend his Excellency's book, "A Russian Province of the North," to all those interested in that country, as it contains much valuable information, now available for the first time to English readers.

TWO SUMMER VOYAGES TO NOVAYA ZEMLYA

CHAPTER I

RUSSIAN LAPLAND

1895

OUR party, consisting of Colonel Feilden, the Rev. H. H. Slater, my brother Mr. Charles Pearson, and myself, met at Newcastle on the 1st of June 1895, and left England that evening on the s.s. *Venus*, one of the mail-steamers of the Bergen Steamship Company. Our voyage across the North Sea was favoured with delightful weather, and shortly after midnight on the 3rd we reached Stavanger, where Feilden and I took the opportunity, whilst the steamer was discharging cargo, to visit the principal parts of the town. The fine old cathedral, built of soapstone, looked well in the northern twilight; and while walking round it our ears were greeted by the note of the Cuckoo and the harsh cry of the Fieldfares from the trees near the lake. We were again under way by 2 A.M., and reached Bergen at mid-day. As we entered the harbour, I was glad to see the little *Saxon* lying at anchor, and the sailing-master, Pedersen, was soon on board. He reported a very rough passage from Liverpool, but the yacht had weathered it well, and was now quite ready to proceed north.

The following day our difficulties began. I had engaged a man beforehand, who was highly recommended, to act as pilot up the

Norwegian coast, and also to accompany us as ice-master. At the last moment he was taken seriously ill, and pronounced by a doctor to be unfit to go to sea. I was therefore obliged to engage another pilot for the voyage as far as Tromsö, and at once wired to Herr Giæver, the British Vice-Consul at Tromsö, to do his best to find a suitable man for the more important part of the voyage in Barents Sea.

We left Bergen on board the *Saxon* in the evening of June 4th, and steamed northward, favoured by splendid weather. The following day was calm, warm, and hazy, so that we had no clear view of the coast-land or the outer islands. That evening we ran into the busy little port of Aalsund to send off telegrams, and had a stroll through the pretty public gardens. This district is famous for its lobsters, and I bought several beauties at a kroner each. Soon after passing the entrance to Throndhjem Fjord, a Hooded Crow's nest was detected inside a circular iron cage, erected as a beacon to mark a submerged rock; and no doubt the owners considered themselves secure there, for the beacon was at least a mile and a half from shore. The nest was a well-built structure, and some of the sticks in it were large for the birds to have carried all the way from the land; it contained two eggs.

Crossing the Arctic circle on the evening of the 7th, we passed Bodö the next morning, and entered the great West Fjord, but unfortunately the beautiful Lofoden Islands were hidden in mist. Hoping the fog might clear, we steamed up the Raftsund, but could only dimly discern the lower outlines of its magnificent scenery; a very different experience from that of a previous voyage, when the mountains stood out clear and sharp in every detail, lit up by the midnight sun.

After paying a visit to some old friends near Sortland, we continued our voyage north, and arrived at Tromsö on the morning of the 10th.

June 10.—We went on shore after breakfast to learn what Herr Giæver had been able to do for us in obtaining another ice-pilot. He strongly recommended Captain Kjeldsen, saying he was sure we should find him a competent man; so Kjeldsen was sent for, and an engagement soon made. I may say here that, having sailed with Kjeldsen three seasons, I consider him a very fine character, and a first-class seaman in every respect, with a knowledge of the ice and its ways equalled by few, if any, of even the Norwegian seal-fishers. He acted as captain or ice-master for Lieut. Payer, Mr. Leigh-Smith, Count Wilczek, and many other visitors to these northern seas.

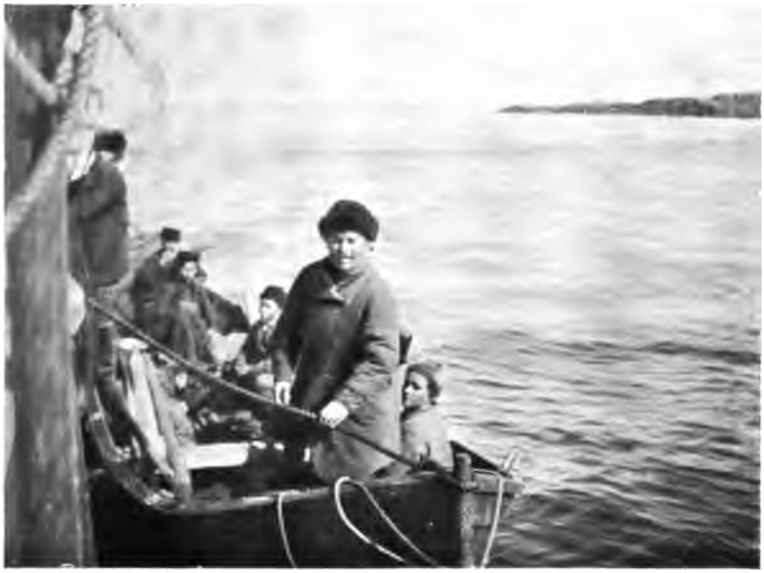
The evening was spent in the woods on Tromsdalen among the birds and flowers, and a very happy time we had there, securing eggs of Fieldfare, Brambling, Mealy Redpoll, and Reed-Bunting. Most of the eggs of the Fieldfares and Redpolls were incubated. We saw several Red-spotted Blue-throats about, but could not discover their nests. A Magpie had young in a low birch-tree, and four young Hooded Crows were brought down from another nest, for we never omitted an opportunity of lessening the number of these rascals.

June 11.—We left Tromsö the next day, and after spending some hours among the birds on the island of Stor Tamsö, arrived at Vardö on the 13th. Here we filled up our coal-bunkers, and also loaded all the available deck space with coal; but even then we could only take on board twenty-five tons. The price of the best steam-coal at these northern ports of Norway varied from sixteen to eighteen kroners per ton, free on board; and a good supply can generally be obtained, as many ships bring a cargo of coal here, and then go on to the White Sea for timber. Having completed our coaling at the rate of about a ton per hour! we cleared out of Vardö on the 14th, and set our course east by north. The wind was nearly dead ahead, and by the next morning had freshened to a half gale. Of all the craft I ever voyaged in, the *Saxon* proved by far the liveliest; in anything like a sea she waltzed about like a cork on the waters, causing large boxes to promenade the cabin in all directions, and wrecking crockery and other fragile things in the most heartless fashion. To add to our discomfort, the cabin stove absolutely refused to send its smoke anywhere except into the cabin; and it was only after twenty-four hours' effort, and clearing off some patent smoke-preventing cowl, that we were able to have a fire. The temperature on deck was 36°, foreboding trouble. During the afternoon, the wind and sea went down rapidly, and that evening we were brought up by the ice-pack. Large masses of ice soon surrounded us on all sides; the sea, as smooth as glass, reflecting all the glorious colours of the midnight sky in beautiful half tones, and the sun shining brilliantly in the north. The effect of the silence of night combined with full sunlight is most striking. Many seals were asleep on the ice, and sometimes allowed us to approach within thirty yards before they glided into the sea.

At this time heavy pack-ice extended north-west, north, and east without a break. We were then in 72° N. by 45° E., the nearest part of Novaya Zemlya being about one hundred and twenty miles distant. During the two next days we worked along the edge of the ice in a south-easterly direction; every likely bight was entered, and in some places these indentations in the pack-ice were followed up for miles, but invariably they ended in blind leads, and we were brought up by impenetrable ice. On June 17th we reached our nearest point to Novaya Zemlya on the 71st parallel, Goose-Land being eighty miles distant. Still working south, and hugging the edge of the pack, we found ourselves on June 18th in lat. 70° N., but the trend of the ice had forced us to the west, and some one hundred and twenty miles from the shores of Novaya Zemlya. Here we were confronted with the difficulty always hanging over us, namely, the paucity of our coal supply. The *Saxon* had now only enough fuel left to take her back to Vardö, whilst little dependence could be placed on her sailing. Our attempt to reach Novaya Zemlya had therefore to be abandoned for the present; so we shaped our course for the Murman coast of Russian Lapland, and entered the Ukanskoe River, to the westward of Sviatoi Nos, on June 20th.

June 20.—We dropped anchor opposite the village of Lutni, a summer settlement of the Lapps, and directly after struck on a

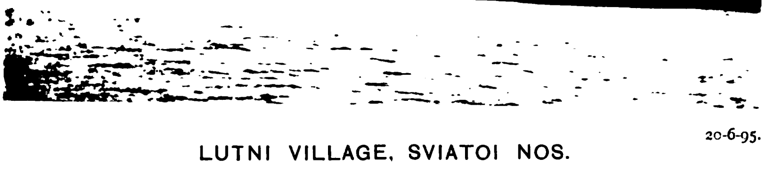
PLATE I A.



RUSSIANS AND LAPPS FROM LUTNI.

20-6-95.

PLATE I B.



LUTNI VILLAGE, SVIATOI NOS.

20-6-95.

rock nearly in mid-stream. As the tide was falling rapidly at the time, we could not get off; and the *Saxon* soon listed over so much, that the water came through the port-holes on to the deck. Some of the men took their kits on shore, but most of us sat on the bulwarks ready to jump should the vessel decide to roll over. Fortunately she thought better of it, and righted herself on the rising tide without receiving any damage.

In the afternoon our tents were pitched on the bank of the river opposite the village, the site being chosen chiefly to avoid the curiosity and frequent visits of the villagers. The larger tent was one used during an expedition in Iceland the year before, and made by Edgington. I can thoroughly recommend this kind for Arctic summer work. The cover is of the strongest white duck canvas (lined throughout with dark blue baize, which adds greatly to the warmth and ensures comparative darkness for sleep during the continuous daylight), and this is supported by a framework of bamboo-poles jointed like a fishing-rod; the whole can be easily packed on a pony's back. When erected the tent measures eight feet long, by nine feet wide, by seven feet high in the centre. The other tent was constructed of a tarpaulin stretched over some boat spars, and scarcely afforded such commodious accommodation.

We felt the change of temperature on landing; for after an experience of cold winds, with the thermometer varying between 30° and 40° for several days, we were suddenly plunged into a heat of 79° in the shade, and the next day it rose to 85°.

In the evening my brother and I followed the proper right bank of the river, in the hope of reaching the lake from which it ran. We soon found a Rough-legged Buzzard's nest on the cliff-face above the river; both birds were about, but the nest was empty, and no eggs had been laid when we left. Early this morning another nest of the species had been found on an island in the bay; it contained four well-marked eggs. The hill-sides were generally covered with dense birch-scrub, which grew six or eight feet high, and made walking both difficult and tiring, although fortunately the air was now delightfully cool. Birds were scarce; and, with the exception of those breeding in colonies, neither birds nor nests are so plentiful in the north as in an ordinary English country district. The fact is, some of us go north with too large ideas; we read the wonderful accounts of the thousands and thousands of birds seen passing to and fro on migration, and utterly fail to realise the thousands of square miles of country over which those birds will spread to breed; so we expect to find them as plentiful as blackberries in one of our country lanes!

Coues's Redpoll, *Linota exilipes*, was abundant in the birch on both sides of the fjord, and round Lake Ukanskoe; while pairs were also scattered over the hills as high as the birch reached. Unfortunately we were rather late for eggs, and most of those taken during our stay were much incubated. We found five nests with eggs and six with young. Both nests and eggs were indistinguishable from those of *L. linaria*. The nests were generally in birch trees, and placed near the main stem; but one or two were found in juniper bushes, twelve to eighteen inches above the ground. They are beautifully constructed to imitate the colouring of the birch-bark, and are among the prettiest of the northern nests. Several Redwings were seen, and one of their nests was found, as well as two of the Meadow-Pipit and two of the Willow-Wren.

After walking some miles up the stream, we were stopped by a large tributary coming in from the left, through a gorge. Standing on the top of the cliff above the junction of the rivers a fine scene lay before us. On the right ran the Ukanskoe River over its rocky bed, its banks sloping gently upwards towards the high ground, and appearing to have once contained a large glacier, which had planed off all projecting points (see Plate No. 3). The gorge below us entered the larger valley at right angles; its cliffs rose vertically from the water in places to a height of 200 feet, in others they were a little broken, and afforded scanty hold for a few birch. The water in the main stream was clear, but that coming through the gorge was of the deepest amber, like the Devonshire Lynn in flood, and coloured the whole river during the remainder of its course. This was rather a puzzle, for the river was low, and the vegetation on the hills above was dry and crisp, showing that no rain had fallen for some time. I was sorry we had no opportunity of fully investigating the matter. Half a mile up, the stream turned at a right angle and ran in a nearly straight line for more than a mile.

In the cliff opposite was a Rough-legged Buzzard's nest: the third nest and the fourth pair of birds seen to-day, so that the bird is evidently not rare here. But what interested us far more was a beautiful Gyr-Falcon on the wing, the first we had seen in a wild state.

We returned along the higher ground to avoid the birch-scrub. Near the top of one of the hills Charles put a Dotterel off the nest, and shot the bird as it fluttered away assuming lameness. It was a male in handsome plumage; the gizzard contained half animal and half vegetable matter, the former consisting of the hard part of beetles, and the latter the seeds of *Empetrum nigrum*, also a little gravel. The nest was a slight depression in the peat, lined only with some lichen. A mile farther, another Dotterel rose from a nest of three eggs; we refrained from shooting it, and were rewarded by a very pretty sight; for as soon as the bird realised that the position of the treasure was known, it tried every artifice to lure us from the spot. It lay to all appearance in the last convulsions of death, six feet off; then it suffered from a broken leg; next a wing drooped, as the bird slowly dragged itself along the ground. Finding all these artifices useless, it proceeded to take a great interest in another spot some twenty yards off, as if a second nest existed there. Finally it came within a few feet and watched us blowing the eggs. Strange to say, these were the only birds of this species we saw in Lapland, although good Dotterel-ground was often crossed.

We got back to the ship at 4 A.M. "dog-tired," at least I can say so personally, for I had had twenty-four hours of real hard work, and some anxiety as to the fate of the *Saxon* on that rock. Still it had been a good day from an ornithological point of view, as the following list of birds, shot or seen, will testify: Redwing, Ring-Ouzel, Water-Ouzel, Willow-Wren, Meadow-Pipit, Coues's Redpoll, Shore-Lark, Rough-legged Buzzard, Gyr-Falcon, Raven, Willow-Grouse, Eider Duck, Goosander, Oyster-Catcher, Golden Plover, Ringed Plover, Dotterel, Little Stint, Temminck's Stint, Arctic Tern, Common Gull, Great Black-backed Gull, Richardson's Skua, Black Guillemot, and Red-throated Diver.

Those of our party who had gone fishing had enjoyed a little sport, securing a salmon trout and some brown trout, all within the area affected by the tide. They found that the Lapps had fixed a most murderous series of nets across the river, just above the high tide mark, making it practically impossible for fish to get up; and several salmon were then fast in the meshes. This was a dreadful sight, of course, for any right-minded fisherman. But look on the other side of the picture. These Russians and Lapps had travelled 200 miles from their winter quarters in the interior to catch salmon; their food supply depended largely on their success, and they meant to catch them in any way they could, without the dread of a Frank Buckland interfering with their practices, or much regard for their future supply. Besides, their fathers had always done so; and if there were few fish this year—a fact—the good Providence would send more next year.

June 21.—At noon we received a visit from some of the headmen of the village. After giving them some slight refreshment, I showed them a series of paintings of birds likely to occur in the district. They at once recognised the Red-breasted Goose, saying it sometimes bred inland near Lake Ukanskoe. This may be true, but I think it far more likely that they saw the bird on its migration. The Smew was also evidently known to them, and was said to breed on some of the outer islands along the coast.

The whole afternoon was occupied in packing stores, &c., for camp. After dinner, Slater, Charles, and I went down the fjord to visit a large island, with some dim hope of finding the Smew. Going there, we marked a Rough-legged Buzzard's nest on the cliff in a rather awkward place, but one of the seamen got to it safely, with the help of a rope, and brought down four eggs.

Our destination was called Medveji Island; it might well have been named after the Black Guillemot, for I never saw so many of these birds together before, quite two thousand being on the sea round it, besides those which were sitting. We obtained a number of their eggs, one specially handsome, with light buff ground-colour. Although the Black Guillemots formed the principal body of the inhabitants, there were several other species; and we noted for the first time here the Wheatear, White Wagtail, Red-necked Phalarope, Shag, and Turnstone. Some fifteen to twenty Richardson's Skuas were about the island, and we found several of their nests containing eggs. There was also a colony of Arctic Terns; some of the nests had eggs that were particularly well marked. Eider Ducks were scarce, and well they might be, for we watched three Lapps (not belonging to the village) working over the island, who shot every duck that was foolish enough to stay on her nest till they brought their old flint-locks to bear on her. These men, knowing we had permission to visit the island, went down two hours before us, disturbed the birds, gathered all the eggs they could find, and came next day to sell them to us. We did not trade, and Kjeldsen forcibly interpreted our views of their conduct.

We returned on board at 3.15 A.M. I may say here, that, from an ornithological point of view, the night is far the best time to work in the Arctic regions, as the birds are generally found on their nests, and return to them more quickly when disturbed; this is very important, for unidentified eggs are worse than useless.

June 22.—A gale blowing from the north-east. Eight large fishing-smacks had come in during the night, and reported very heavy weather outside. This place is one of the most sheltered anchorages on the Murman coast; and being so close to the entrance of the

White Sea was probably often used by our fleet while blockading Archangel during the war with Russia.

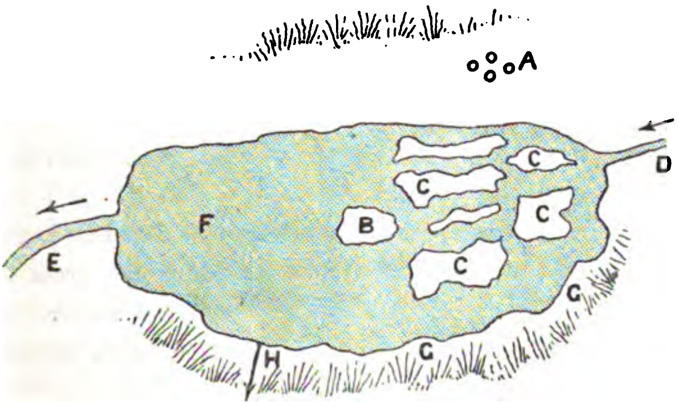
It was late in the evening when a start was made to explore the country to the east of our anchorage. The first discovery was a Red-throated Pipit's nest with five eggs, and a second nest with six was afterwards found. The bird is common locally throughout the district, especially round the tarns and more marshy ground, where it takes the place of the Meadow-Pipit; but its eggs vary much more in colour and marks than those of the last-named species. In all the nests which my brother and I found in Norway, in 1893, there were a few horse-hairs or fine black roots interwoven with the grass-stems which formed the lining, but no trace of this peculiarity was noticed in Lapland.

The country we were crossing was a high tableland, of marshy character, with many tarns, on one of which a pair of Scaup-Ducks were feeding. While watching these birds, a small white patch caught my eye in the distance; turning the glasses on it, I saw a Buffon's Skua sitting on the ground! This must mean a nest, and away we went across the tundra towards it. The bird rose as soon as we started in its direction, but we held on in a bee-line for the spot, across bogs and all other impediments. After considerable search, the nest with two eggs was found, placed near the centre of a large flat mass of dry peat, some twenty yards long by ten yards wide, which stood three feet above the surrounding bog. The nest itself was a slight depression, containing a few bits of lichen, on which the eggs lay. The bird was very wild, so we left it for an hour and a half, and on our return it proved to be another instance of the male bird incubating. It is curious how thoroughly the eggs of all birds which nest on the open ground harmonise with their surroundings, although they vary through so many shades of green and brown.

Continuing our walk towards the higher ground, we found a nest of Coues's Redpoll close to the limits of birch-growth. A hundred yards off was a Rough-legged Buzzard's nest, placed on the edge of a small cliff, with absolutely level ground behind it; we walked to it as easily as if it had been on a road. A young one in white down and two eggs lay in the nest; both the latter were nearly hatched; in fact, one bird had its beak through the side, and was calling so plainly it could be heard several yards away. After reaching an elevation of 500 feet, we returned over another line of country, finding only a Red-necked Phalarope's nest, and reached the ship at 5 A.M.

June 23.—After divine service on board we moved into camp, the rest of the day being fully occupied in producing some degree of order in the tents.

June 24.—Slater, Charles, and I went to Lake Ukanskoe, Feilden preferring to investigate the country to the north. The lake lies south-west by west of Lutni, at a distance of five miles, and is 300 feet above sea-level; some of the intervening hills rising to 650 feet. The following sketch plan will illustrate its general contour:—



LAKE UKANSKOE, RUSSIAN LAPLAND.

A. Lapp huts for the men in charge of the reindeer; all hope of the nests of Red-breasted or other Geese vanished on sight of those huts! B. A large sandbank surrounded by very shallow water. C C. Islets composed of debris carried in by the stream; most of them were covered with dense sallow scrub. The Ukanskoe River flows in at D.

from some lakes above, which we had not time to visit, and passes out at E., whence it sweeps round to the left in a large curve to the point of junction with the stream, described on the 20th. All the lower part of the lake at F. appears to be of considerable depth. Steep hill-sides slope down to the lake at G G., and were covered with birch, some of the trees reaching a height of fourteen to sixteen feet. The trail from Lutni strikes the lake at H., where we found a very cranky boat which required much bailing, and this we "borrowed," to visit the islands. On reaching the largest, we saw a number of Temminck's Stints, and soon found several nests, all made of a little fine dry grass, and placed amongst coarse herbage. Of three birds on the nests, two were males and one a female. This species was also breeding between Lutni and the shore, close to the houses, and evidently does not object to the presence of man, for I once found a large colony among the houses of a small village in the north of Norway, where an offer of sixpence per nest to the little girls of the place brought in such a supply I was quickly obliged to cry, "Hold, enough!"

We also saw about twenty Wood-Sandpipers among the islands, but could not find their eggs. In a female shot, the eggs were only beginning to pass down the oviduct, so that the species appears to be a late breeder.

A Shore-Lark's nest, with four eggs much incubated, was found on another island; it was placed amongst some fine grass on sandy ground, ten feet above and eighty yards from the water. Although this species was generally to be seen in the district, no other nest was taken.

The woods at G G. contained many Redwings (we saw no Fieldfares in the country) and Coues's Redpoll; the nests of the former were empty or contained young birds, and were generally placed in the forks of the birch-trees. Willow-Grouse were also plentiful, and must afford good shooting here in the autumn. Only one nest was taken during our stay in the district, with nine incubated eggs, but one or two recently hatched coveys were met with. A few Lapland

Buntings were seen near the lake. Willow-Wrens were plentiful, as they were all through the country, and we rarely went out without finding their nests; a full clutch generally consisted of six eggs, for we only twice found nests with seven. While walking through the wood, Slater detected the note of the Sedge-Warbler, and shortly after succeeded in shooting a male; two more of the species were both seen and heard there. Directly after, a Great Snipe was flushed from its nest of four eggs; the nest was placed in the centre of a tussock of coarse grass, at the edge of a willow swamp, surrounded on all sides by birch. White Wagtails, Red-spotted Blue-throats, Long-tailed Ducks, and Goosanders were seen; also a Scoter, as to the species of which we could not agree, the dispute waxing hot as to whether it had —or had not—a white wing-bar. On the hill above the wood was a large perched boulder, nearly equal in size to a small cottage, and a pair of Rough-legged Buzzards had selected it as a good site for a nest. These birds can be little disturbed by the natives here, or they would choose more inaccessible places for their nests. My experience in the North has been that birds which lay eggs useful for food are robbed on every opportunity, but that all others are undisturbed, and little or no notice is taken of their nesting habits.

The night was cold—about five degrees of frost, I should think —and although the sun continued an unclouded course round the heavens, the shadow of the hills prevented his influence being felt on the lake-side, so that all vegetation became covered with thick white hoar-frost, the flowers drooping nearly to the ground. We felt specially sorry for the beautiful Trollius, they had so far to bend, and looked as if their case were hopeless; but before we left, the sun was again shining on them, the hoar-frost was gone, and they were as upright and fresh as if just rejoicing in the summer warmth for the first time.

June 25.—The next day a sharp change had come over the weather; it was wet and stormy, and the wind raised such waves on the fjord below us, we thought it scarcely safe to cross to the other side. Feilden had found a Red-throated Diver's nest with eggs the day before, on an islet separated from the tarn-side by water just too deep for wading and too wide to jump. So after dinner he and I walked up the hill, taking a long rod with a small net attached to the end of it. Imagine our pleasure, after climbing several hundred feet and walking three or four miles, at finding only a little white-of-egg left in the nest! The thieves who had anticipated us were evidently two Richardson's Skuas, which had been seen near the nest the day before. They were still there, and seemed to have a local interest beyond the appropriated Diver's eggs; so we settled down behind a boulder, determined to have our revenge if possible, and an hour later, when we walked down the hill with two eggs and both of the old birds, we felt better! The male bird was of the uniformly dark variety and the female of the white-breasted form.

June 26.—Slater, Charles, and I crossed the fjord at mid-day, to hunt over the low-lying land to the right of that traversed on the 24th. There was little of interest to record respecting the country, beyond its birds and nests. The first of the latter found was a Ringed Plover's, and was lined with bits of white quartz. Then Slater put a Redshank off its nest on the shore of a tarn, within six inches of the water. He also found three nests of the Meadow-Pipit, one in a tussock surrounded by water, a much wetter position than usual. Two nests of the Red-throated Pipit were seen, the second with seven eggs, an unusual number. A Rough-legged Buzzard's nest with two eggs about to hatch, was placed on a rock-face not fifteen feet high; the position was sheltered from the weather by an overhanging ledge, but the nest was as easily taken as a hedge-bird's.

Feilden was anxious to see the gorge we had visited on the 20th; so he, Charles, and I started at 11 P.M. We first ascended the hills behind the camp, to inspect a moraine which Feilden had noticed a few days before. It was a very large one, and told a wonderful tale of the amount of denudation this country has undergone.

PLATE 2 A.

23-6-95.

OUR CAMP ON THE UKANSKOE RIVER OPPOSITE LUTNI.

PLATE 2 B.

"A PLEASANT PATHWAY," TRAVERSED 26-6-95.

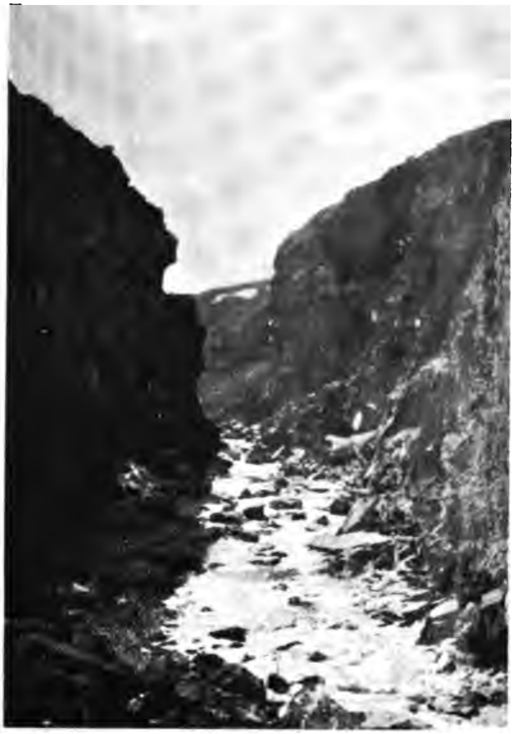
Situate 475 feet above sea-level, it extended more than half a mile along the tops of the hills. Unfortunately I had only a "snap-shot" camera, and there was not enough light to photograph by, at least that was the record of the film afterwards. Leaving the moraine, we followed up a small stream running through a series of little tarns, its banks surrounded by dense masses of willow scrub, and saw four geese fly over, two of which settled on a marsh opposite, where they joined three goslings running through the scrub. We gave chase at once, and after a smart run, two of the little fellows were secured and put in a fishing-basket; but in a minute both were out through the hole in its lid! One succeeded in getting off down the stream; the other youngster was tied up in a handkerchief to prevent further wanderings. After watching a short time in the scrub, we succeeded in bringing down the mother, a Bean-Goose, thus deciding one species of goose for the district. In the race for the goslings, we had put up a Willow-Wren, Red-spotted Blue-throat, and a Meadow-Pipit from their nests. The Blue-throat is very like the Robin in its choice of locality for breeding. This nest was concealed in the side of a large patch of coarse herbage close to the stream; it contained seven eggs, on which the female was sitting. After working for some time among the waders, it is really a treat to find the female bird attending to her duties.

Then followed some miles of the worst country I ever travelled over. It was entirely covered with blocks of granite from the size of one's head to fifty tons or more; frequently no block presented a flat space for the foot to rest on for many yards; it was a constant effort to balance and step from point to point. That was a walk that none of the party will forget quickly. The illustration on Plate 2 will give some slight idea of it. Yet even this tract supported some life, for a White Wagtail had her nest with six eggs among the stones in one of the worst parts.

At last—7 A.M.—we struck the ravine, and saw that the stream below was still of the same rich amber colour as on the 20th. The wind through the night had been piercingly cold, but the sun now obtained full power, and brought out hosts of mosquitoes. I have never yet met two men who could agree as to whether the mosquito of the Tropics or of the Arctic is the worse. In fact, when men begin to discuss the subject they generally lapse into tales by the side of which those of the ordinary fisherman sink into absolute truth. We soon found the nest of the Gyr-Falcon; it was placed in a small recess half-way up a sheer wall of rock, quite inaccessible without a rope. A young bird, partly feathered, was sitting on the edge of the nest, and probably others were inside. Both old birds were in sight, the female being much the more bold in approaching us to protect her young.

On our return we went lower down the river valley to avoid the stones, but this only led us into greater trouble, for we had to force our way through long stretches of dense birch-scrub under a burning sun, and without a breath of wind to clear away the mosquitoes. They settled on every particle of exposed flesh, and the thousands who failed to find room there covered our caps and backs, till the colour of the cloth was nearly hidden. We reached camp at 11 A.M. thoroughly done up, and even then we could not sleep, our blood being so feverish from the mosquito bites. My neck and wrists were swollen up with lumps the size of sparrows' eggs. Unfortunately our mosquito-nets had been left in camp, as we had quite enough collecting gear and guns to carry, and expected to be home hours earlier. Oil of lavender gives temporary relief from persecution, but its effects soon pass off. A mixture of half turpentine and half olive-oil is also useful in ordinary cases; but when the enemy are brought into good working order by a hot sun and calm day, nothing stops them except a veil. This desire of the mosquito for blood is a strange puzzle. Not one in a million, nor any of his ancestors for generations in the Arctic, can have tasted it; yet all rush for the first human being or reindeer they meet. I have heard of the Samoyeds being driven mad by their bites, and

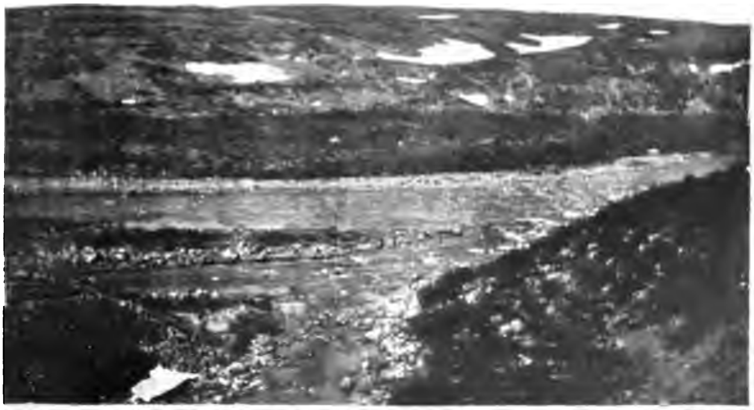
PLATE 3 A.



26-6-95.

RAVINE, LOOKING UP STREAM.

PLATE 3 B.



26.6-95.

JUNCTION OF RAVINE WITH UKANSKOE RIVER.

the tame reindeer are all taken to the hills or islands during the summer to avoid them.

June 27.—We were just starting for the hills after dinner when the *Saxon* appeared in the fjord. Camp was struck at once, and we left Sviatoi Nos soon after midnight for another attempt to reach our goal, Novaya Zemlya. Passing Cape Kanin the next day, we sighted Kolguev on the 29th, and a few hours after we again met our old enemy, the ice. From this time till the evening of July 2 we passed through a series of fogs, storms, and general discomfort, the ropes sometimes coated with half an inch of ice. At 6 P.M. that day a clear and expansive "lead" appeared in the pack to the NNE., which we followed, aided by a good south-east breeze, and at 11.30 P.M. land could be clearly seen from the deck. This was "Goose-Land," the large area of flat tundra projecting on the western side of Novaya Zemlya proper; but between us and it lay some eight miles of dense ice.

We steamed on towards the north, fully expecting to land at Nameless Bay on the morrow; but alas! by 4 A.M. the next morning the ice had forced us in a north-west direction. We were twenty-six miles from the nearest land (North Goose Cape), and the whole sea to the north was blocked by ice of a much heavier description than any we had yet met. Evidently this was not a desirable position, so we turned at once. The ice had closed in behind us, and caused some difficulty, for the *Saxon's* steam-power was scarcely able to contend with it. Fortunately a bright sun and calmer weather assisted us, and at 7.30 we were again in open water. At eight the fog came down so densely we could only see a hundred yards from the ship, and this continued till 11 P.M. We jogged along the edge of the ice at half-speed, spending the day in shooting birds; some Brünnich's Guillemots, two Pomatorhine Skuas and one Mandt's Black Guillemot were secured. We also saw two Siberian River-Gulls, several Buffon's Skuas, Arctic Terns, Fulmars, and Little Auks.

At midnight the air was again clear, and we could realise our position. Between us and South Goose Cape lay ten miles of nearly solid ice. Kostïn Shar, the only safe anchorage on this part of the coast, could be seen far down on the south-east horizon, parted from us by an impenetrable pack; in fact, whichever way the eye turned from the masthead all was ice, except one long lead to the south-west, some three miles wide. A council of war was held. Kjeldsen and Pedersen both urged that the *Saxon* was totally unfit to remain there and encounter the ice; and our old difficulty also forced itself to the front, for only eleven tons of coal remained, just enough to take the ship back to Vardö. So, very reluctantly, was it decided that we must return. That was a bad time, made none the easier by watching the sun light up the snow-clad mountains beyond Goose-Land. In the clear morning air it almost appeared as if we could walk over the ice, and land without much difficulty. Before turning in I resolved to send the ship for coal, and make one more attempt to reach the country that was fading in the distance.

Our lead through the ice served us well, and continued from three to ten miles wide until 5 A.M., when we reached open water on the starboard; on the port-side the ice was densely packed till we reached Kolguev. During the night we passed two Norwegian sealing-ships, both of which were soon after caught in the ice, and though one finally escaped from it in August, the other was lost.

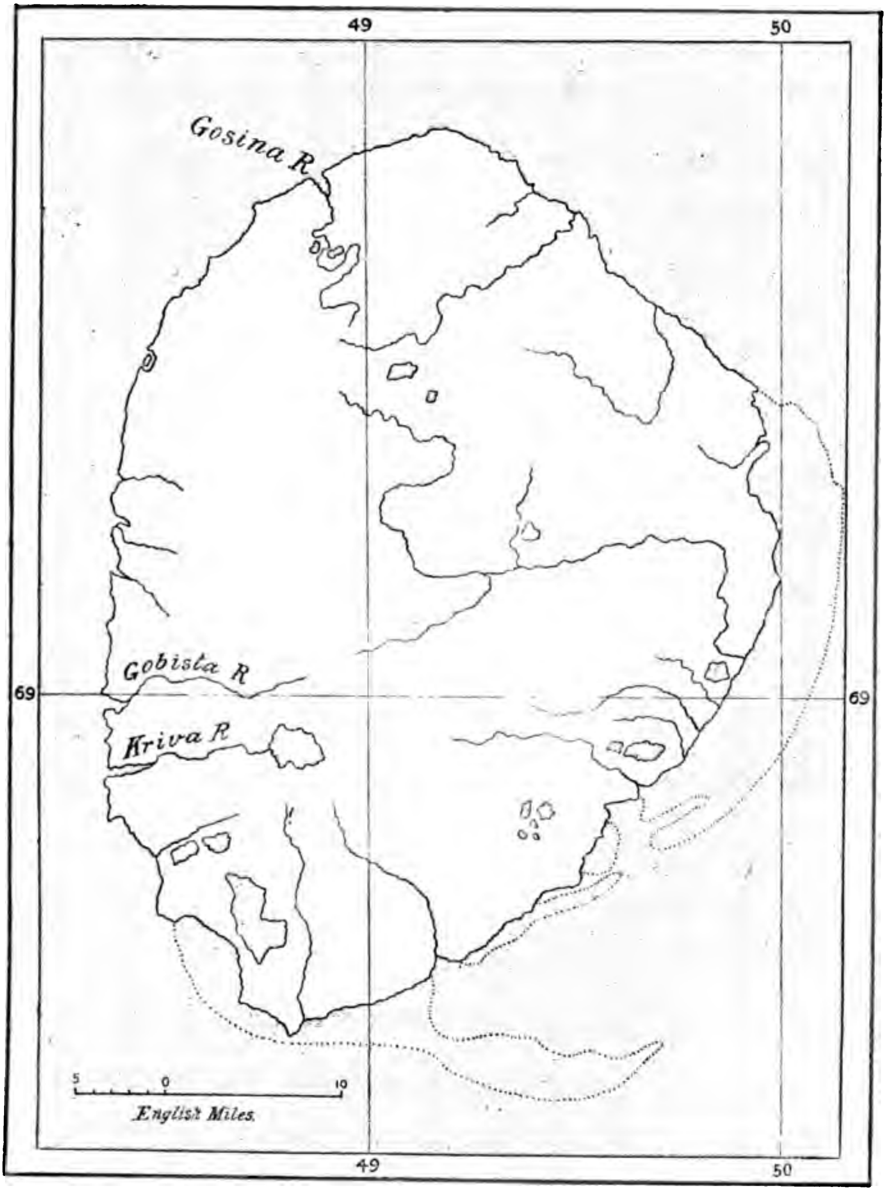
CHAPTER II

KOLGUEV

AN important question now arose as to what we should do with ourselves while the *Saxon* went for more coal. Knowing, from the experience of previous voyagers in Barents Sea, the probability that the ice might prevent our reaching Novaya Zemlya, we had often discussed, while sailing up the Norwegian coast, what would be the best course to pursue in such a case, and it had been decided to try the Murman coast, as well as to avoid the island of Kolguev, whereon Mr. Trevor-Battye had done good work the year before. But under the present circumstances, Kolguev appeared to be the only available place left, and the accounts which he had given of the Grey Plover and Little Stint nesting there proved a great attraction. Inasmuch as Mr. Trevor-Battye had traversed much of the NW., N., and SE. of the island, we decided to land on the south-west part, if possible.

July 5.—Steaming down the west coast, two miles from land, we sighted a river we first thought to be the Kriva; but it afterwards turned out to be the Gobista. As it appeared to be a suitable spot, the ship was anchored in three fathoms, a mile from the shore, and we landed at 2 A.M. to select a place for the camp, receiving at once a hearty welcome from crowds of the inhabitants (mosquitoes). The warmth and brightness of the sun brought them into full activity, even at that early hour; and they helped our choice of a spot materially, for it was clear we must be on the top of the bluff to benefit by any cool breeze in dispersing them. Although the sea was now perfectly calm, the sky showed signs of a change, and the wind was veering round towards the east. Evidently no time could be lost in going farther south, and all hands were at once busy in landing stores, erecting tents, &c. Rapidly as they worked, the tents were not completed when a storm broke over us, with rain and heavy wind, accompanied by vivid flashes of lightning. At one time there appeared some danger of the ship being driven off the coast, leaving half the crew on shore with very little food. Fortunately the storm soon passed away, and allowed us to finish in more comfort. The *Saxon* sailed for Vardö at 7 P.M. The last boat left the island through a rising surf with some difficulty, and for the next ten days there was never an hour when it was possible for a boat to reach the shore.

Things being a little ship-shape in camp, we had time to pay more attention to our new country. One point was clear at once, and subsequent experience only confirmed it:—this island of Kolguev will never become a regular resort of the ordinary tourist, nor will the value of freehold property here seriously increase! It has not the slightest pretence of a harbour on any part of its coast; and I believe there is no place where more than three fathoms can be found within a mile of land. "Scenery," in the ordinary sense, there is absolutely none; its shores are sad-coloured bluffs of glacial mud; its rivers shallow streams, impassable by even the smallest ship's boat, and flowing through great marshy hollows full of more mud; its "mountains," a few sandhills, the highest not exceeding 250 feet; its forests, dwarf sallow-scrub some two feet in height; its plains, destitute of anything we call grass, and covered with many coloured lichens and sedges. It is just one great heap of glacial mud with a few low sandhills, and has not a single rock *in situ;* at least Mr. Trevor-Battye never saw one, neither did we. Often in a river there is some eddy, where the waters deposit part of the mud and sand they have carried down from the upper reaches. Probably Kolguev was once such a spot, where the currents of the ocean detained the ice-sheets from the mainland, until they had deposited their burden of rocks and mud; thus forming a great bank, which had been gradually raised above the sea level during recent geological time, together with the whole northern coast of Europe.



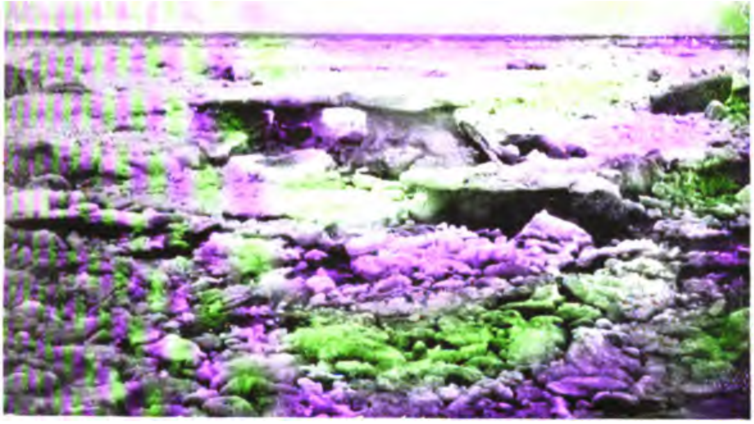
KOLGUEV ISLAND.

Before proceeding further, it will be well to say a few words respecting the immediate surroundings among which we were to spend the next ten days, and the description will be the more easily understood by reference to the plates. Plate 5A is taken from the north bluff on the opposite side of the river to our camp. On the right of the picture is the sea, separated by a broad and high shingle bar from the estuary of the river, which occupies all the centre. This shingle bar was the most extraordinary collection of stones I ever saw—granites and gneisses, Silurian and Carboniferous limestones, grits, quartzites, porphyries, and many others were mixed up in endless confusion. They were evidently the remains—"riddlings" will be far more expressive of my meaning, although it is a somewhat local word—left from the denudation of the great river valley. The bar was pierced near our bank by a narrow passage, through which the Gobista flowed.

As has already been stated, the tents were pitched on the highest and driest point of the south bluff overlooking the river; yet even here a hole a foot deep (excavated for a beer-cellar) soon contained three inches of water; and if the surface soil was much trampled, it quickly assumed the consistency of a hasty pudding. There was no drinking-water of good quality, and our supply was obtained by melting the snow from a large drift twenty yards below the camp.

The next photograph (Plate 5B), on the same page, was taken looking up the estuary of the Gobista from the bluff above shingle bar at low tide, and shows how the river winds about among great mud flats. The Gobista runs from east to west through a broad valley from one to three miles wide, which it has excavated, with the assistance of spring floods, frost, and snow, in the soft clay of the enormous glacio-marine deposits composing this part of the country. The bed of the valley is chiefly marsh, with numbers of lakes and tarns scattered over its surface, many of them showing evident signs of having once formed part of the river. The bluffs forming the valley's sides rise fifty or sixty feet above the sea

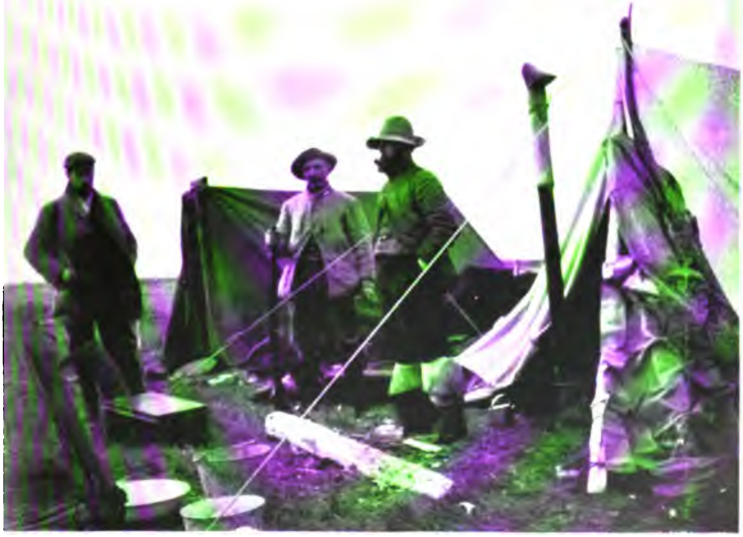
PLATE 4 A.



"ICE-BOUND ON KOLGUEV."

8-7-95.

PLATE 4 B.



OUR CAMP ON KOLGUEV.

6-7-95.

level, and have been cut out into a series of bold curves by the river, forming large bays one or two miles across, up its whole course. The edges of these bluffs are the driest part of the country we saw, and have a slight coating of peat, on which grows a variety of beautiful lichens; their greys and browns produce such pretty harmonies of colour, we often wished we could carry away accurate records of them. It will be seen at once that this country afforded a great diversity of feeding-ground for the birds. In the estuary were numbers of Long-tailed Ducks and King-Eiders, also a few Glaucous and Siberian River-Gulls. As we advanced up the river, these were replaced by several members of the Charadriidæ family, while on the dry ground there were Willow-Grouse and Buntings. Unfortunately we had no means of locomotion besides our legs, and the possible investigation of the country was therefore confined to a comparatively small area; for however anxious we might be to extend our explorations, we soon found that eight or ten miles from camp was the greatest distance accessible over such a country in even twelve or fourteen hours. Then there were the endless delays caused by hunting for birds and flowers; in fact, we were not there to explore the country, but to study its natural history, and every excursion had that object primarily in view. We saw nothing of the inhabitants of the country, the Samoyeds, who had so kindly entertained Mr. Trevor-Battye the previous year; but we met with their recent sledge-marks in all directions, and round our camp were several large heaps of timber, collected by them from the shore. We appropriated that timber freely, for what could be more tempting than a large stack of dry wood close to the fire? But in return we left them a collection of empty tins, a few needles, and other trifles, doubtless of more value to them than the wood we burnt. The Samoyeds generally reside on the south-east end of the island, and had probably returned home to prepare for the annual "goose-catching," the most important event in their year.

In the evening we started over the tundra towards the south, and found several large sheets of water, much marshy ground, and mosquitoes in plenty. Our necks and hands were almost as bad on reaching camp as after that memorable walk from the ravine on the Murman coast. Birds were scarce in that direction, and large areas of tundra seemed destitute of all but insect life. Young Lapland Buntings, Snow-Buntings, and Dunlins were on the wing. These two Buntings were the commonest birds in Kolguev. The male birds of the former species were constantly to be seen and heard in all parts of the tundra; they sat on some mound until we approached, evidently giving the alarm note to the female, and then flitted on to some farther point, accompanying us till they thought danger to their nests was past. Before we left, family parties were on the wing preparing for migration. We found nests of the Snow-Bunting containing young on the day we landed, and by the 15th many of the young were flying about the tundra. The nests were chiefly placed in fissures formed by rain and frost in the edges of the bluff, above the sea and water courses. The following birds were also seen: Ringed Plover, Grey Plover, Red-throated Pipit, Little Stint, "Grey" Geese, Swan, Willow-Grouse, King-Eider, Glaucous Gull, Richardson's Skua, Black-throated and Red-throated Divers; while quite a hundred Long-tailed Ducks were feeding in the estuary. We were glad to get back to camp at 2 A.M., for none of us had slept more than two hours during the last forty-eight.

July 6.—We were awakened at 11 A.M. the next morning by being nearly blown out of bed, for a strong south-east wind was trying the construction of our tents rather severely. After breakfast I went down to join Feilden, who was botanising in a marsh between the camp and the river. Before reaching him a Little Stint crossed in front and went into some thick herbage; a short search revealed the nest, a light structure of fine grass, well concealed among the coarse marsh plants, and containing four pretty eggs. I shot the bird, that the eggs might be identified without doubt. There are a few joyful moments that stand out clear and sharp in the memory and will never be forgotten while life lasts—the finding of this first Little Stint's nest is one of them.

The bird shot was a male; in his stomach were four small beetles, one caddis-fly, one crane-fly, and a large number of semi-transparent larvæ, possibly those of the mosquito. We afterwards found this species was fairly numerous on both sides of the river as far up as it was affected by the tide, but no nests were seen beyond that point. The nests were in all kinds of positions—among coarse herbage on the low marshy ground (as the first described above); on dry ground at the foot of the bluffs; on the sides of the bluffs, among dwarf sallow three to five inches high; and on the tundra among fine low grass, some little distance from the edge of the bluffs. The date of incubation varies considerably, even in the same year, for while some clutches found on July 6th were more than half incubated, others obtained on July 14th were quite fresh. In colouring, some eggs are beautifully blotched with burnt sienna on a pale shade of the same colour, others on pale green ground; while some are much more finely speckled, and rather resemble the eggs of Temminck's Stint.

We had retained one of the *Saxon's* boats, and after lunch my companions and I crossed the river in her to the north bank. Its bluffs facing the south were perfect little gardens of Arctic flowers, beautiful not only in comparison with the dreary tundra around, but able to hold their own with many English ones. Blue gentian in masses; lovely clumps of forget-me-not, with the flowers apparently stalkless, resting on the close-growing leaves in such rich profusion that the latter could be scarcely seen; yellow violas, buttercups, marsh marigolds, globe flowers, and potentilla; *Silene acaulis*, showing great masses of pink blossoms, and many others, made up a lovely picture, and gave our botanists a happy hour. Two Little Stints' nests were found on the bluff-side among the dwarf sallow.

Our return was hurried by a heavy thunderstorm coming up from the south. Fortunately we reached the tent just in time to escape a drenching. A fog in the evening prevented an expedition we had planned up the river, so we had to content ourselves with crossing the estuary and working through the marshes on its north bank. Here a pair of Glaucous Gulls had two eggs on a mound three feet high, which looked very like an old swan's nest. Finding little on the marshes, except very bad walking, we struck across a rough piece of boggy tundra, and when a mile from the river we put a Long-tailed Duck off her nest with eight eggs. She sat till we were four feet off, harmonising perfectly in colour with the black peat and its patches of lichen.

Several Red-necked Phalarope were seen about some tarns here, but no nest was located, nor did we find any during our stay on the island; no doubt the birds were breeding there, and a more careful search would have proved it. I fear our minds were too full of Grey Plovers and Little Stints to condescend to Phalaropes! Returning to the river bluffs, we were soon met by three or four pairs of dreadfully noisy Turnstones, and a large area was carefully searched without result, although the birds were so clamorous we felt sure they must have young. Giving them up at last, we turned to the west, in hope of finding a lake which Cash, the steward, had visited yesterday, where he saw two swans. A mile farther a Turnstone rose and ran rapidly to the left, then stopped and began to call. Going direct to the spot it rose from, I found a nest containing three young in down and one egg, the latter apparently quite fresh. I have often noticed that birds of this and allied species generally run sharply to the right or left of the nest before—as they think—disclosing themselves; very rarely do they either advance or retire in a line with the disturber of their peace. If the observer believes the bird to have a nest, and has failed to note the place it first rose from, his best course is to drop flat on the ground and wait there, carefully watching every movement of the bird through his glasses during the next forty or fifty minutes. In that time it will probably return to the nest, or he will be able to form a good idea whether there is one.

The Turnstone's nest was only a slight depression in the black peat,

PLATE 5 A.

GOBISTA RIVER AND SHINGLE BAR, LOOKING SOUTH.

PLATE 5 B.

6-7-95.

GOBISTA RIVER, KOLGUEV, FROM NORTH BANK.

lined with a few bits of lichen, and placed on a large piece of flat land, without the slightest protection. When examining a skin of this bird, it must strike a naturalist as being one of the handsomest and most distinctly marked among birds breeding in the Arctic region; yet so well did its black, white, and russet agree with the tone of colour pervading the tundra, that I often heard the bird long before I was able to see it. Not that it greatly needs any protecting similarity of colour, for it is a bold bird, well able to make a good fight for its eggs or young. We had no opportunity of obtaining sufficient material to decide whether the male or female took chief part in incubation; but it was clear that No. 2 watched over the safety of No. 1, and at once gave the alarm when danger appeared. If the warning were caused by the presence of one of those arch-villains of the bird-world, a Skua, both Turnstones at once rose into the air and "went for him" in a style that quickly caused a hasty retreat; but when a man invaded the nesting-ground, they settled within easy shot, and, running backwards and forwards, uttered a series of loud angry cries, which not only brought every Turnstone within a mile to the rescue, but alarmed all the other birds.

Shortly after leaving the Turnstones, a Dunlin was flushed and one of its young in down caught. This bird was common in all the more marshy parts we visited. A nest with four eggs much incubated had been discovered by Feilden directly after landing, but most of the Dunlins had young, so they must have commenced nidification earlier than the other *Limicolæ* here.

Then a Shore-Lark, rising close to our feet, revealed its nest with three eggs, placed as usual by the side of a dried tussock of coarse grass. The bird must excavate a hole in the peat for the nest, as it is always sunk till the edge is level with the surface of the ground. In every case the outer part was made of fine grass, and the inner lining of the fluffy down of the willow, bog-cotton, or Arctic coltsfoot (*Nardosmia frigida*). The birds generally sat very close, and their colours agreed well with the surroundings. We never found more than four eggs in a nest on Kolguev, although after-experience showed this number is sometimes exceeded. Shore-Larks were far more numerous here than in any other country we have visited; and they either vary very much in the time of nesting, or else they rear two broods in the season, for while young birds were on the wing when we arrived, we continued to find fresh eggs up to the day of our departure.

At last we reached the lake which Cash had mentioned, but no Swans were there; only a Red-throated Diver, and its nest with one egg. Turning for camp, Charles located a Little Stint's nest on the tundra, more than a mile from the river. As we were blowing the eggs, the poor little bird repeatedly settled on the empty nest close to our feet, and then got up with a reproachful look, as if asking where its eggs were. Then it came within two feet of Charles and watched him blow the last egg. This bird has no fear of man, because it has never learnt to look upon him as a dangerous animal; it spends the summer in regions rarely visited by him, and the few specimens of the species it meets with there are not of the "collecting" Englishman type. During the remaining nine months of the year it finds in sunny Africa a race of bipeds with darker skin but equally harmless as concerns itself, so that only on migration is there an opportunity of understanding the risk connected with man. I have seen a Little Stint perch on the barrel of a gun as it lay a foot from my side.

To-day we had the pleasure of recording a new bird for the island, namely, the Mealy Redpoll. It was a young male in first plumage, with yellowish crimson crest and spotted rump, and was shot near the camp. Possibly it had been blown off the mainland by the storm.

Although the fog continued all night, we could generally see quite half a mile of the country around us, so there was little difficulty in finding the best line to take. We got back to camp at 4.30 A.M., and these notes for the day were written after that hour, as I lay in bed under the tarpauling tent, the flap half open to obtain light, in spite of a keen south-east wind that brought the thermometer to freezing-point.

July 7.—The cold and fog of the previous night were at once explained when Cash woke me with the news the whole coast was blocked by ice. It was coming down from the north in a stream nearly a mile wide, and travelling at the rate of three miles an hour; large masses were constantly grounding on the shore, forming a dense continuous barrier, over which the swell caused by a strong south-west wind broke as it does on a rocky coast. The ice was travelling against the wind here; but, on consulting Pedersen's log afterwards, we learnt he had experienced northerly gales at Vardö, which had doubtless extended over Barents Sea and forced the pack down on Kolguev. A photograph, reproduced on Plate 4, was taken twenty-four hours after the ice first appeared, when it had been broken up into small fragments by the south-west gale. The day was anything but pleasant, fog and cold winds which chilled to the bone, and convinced you that the thermometer, hovering about 35°, must have gone wrong; still there are always compensations, the mosquitoes had gone to bed! Fortunately a small stove had been brought on shore with a few bags of coal, and proved a great comfort. All hands were busy for some hours in building a good wall of earth round the sides and back of tents, to break the wind a little. A tent should have an entrance at each end; then the opening can always be made to leeward, however the wind may shift.

Feilden, Charles, and I crossed the river in the evening and walked up-stream under the bluffs some distance beyond the point reached the previous night. We passed many beautiful masses of flowers growing on the more sheltered faces of the bluffs. A little beyond the point reached by high tide we found a nest of Temminck's Stint with four incubated eggs, and shot the bird to ensure identification. This species is much wilder when breeding than the Little Stint, and is decidedly uncommon on Kolguev, where we only secured two of its nests.

We had travelled some five miles from camp, and had decided to turn to the north, when a Red-throated Pipit rose from its nest just in front. The latter was in a large tuft of sedge-like grass surrounded by water, in a very wet tract of marsh, and contained six of the handsomest eggs I have seen of this species; they varied from a rich dark maroon-brown to a light pinky buff, but unfortunately they were too incubated to be blown. These Pipits were seen in most of our walks, but were not common. We never met with the Meadow-Pipit on Kolguev; and Mr. Trevor-Battye only saw a flock in August, which appeared to be on migration.

Soon after gaining the top of the bluff, a Grey Plover was seen in front, pretending to be lame; and as this certainly indicated the vicinity of a nest, we lay down at three points to watch the bird. Two Turnstones immediately came to assist in watching us, and kept up an incessant din, making the Plover still more cautious. Forty-five minutes did we lie on that hillside in a biting wind and sleet before the bird would settle. My brother was the fortunate man, for the nest was out of sight from our positions. Dropping his knapsack to mark his point of observation, he walked up to the spot he believed he had seen the bird on, and planted his stick there; when we joined him at once, and all searched carefully, but without result. Then Charles returned to the knapsack, and again walked up to the stick, when he found the nest in a direct line between his two points, but twenty yards nearer the base. Few persons realise the difficulty of walking over several hundred yards of broken country to find a bird's nest agreeing in colour with its surroundings, and without any distinctive mark in the immediate vicinity. The nest was a slight saucer-shaped hollow, lined with small sallow-leaves and lichen, surrounded by lichen and moss; and the four eggs were more than half incubated.

July 8.—We reached camp at 7.30 A.M., and before going to bed I took a few photos of the ice off the coast. It was well I did so, as this was the last chance of recording anything to be described as "Ice-bound on Kolguev," for the gale completely broke up all the ice during the next few hours. At 9 A.M. the sun was at last shining again faintly, and made the interior of the tents comfortably warm; but this pleasant change was of short duration, for I was awakened out of my first sleep by the cold; and the afternoon was wretched, fog, heavy wind, and rain. As for washing, a glance at the bucket filled with water and snow was quite enough for me. Chopping up the Samoyeds' wood was an occupation greatly in demand that day, for it assisted the circulation a little.

Charles and I turned out at 2.30 the next morning to hunt for Grey Plovers. We found a pair on the tundra, and sat down for an hour to watch; but neither bird showed any intention of settling. We had just decided we could stand the cold no longer, when I noticed another bird rise at a Skua some distance away; on our approaching, it ran sharply to the right and rose into the air. Slater came up just then, and joining in the search, found the four eggs, which were incubated. It was the male bird (in handsome breeding plumage) that had been sitting on them. We generally found the male Grey Plover was the bolder bird, and the one to take most risk in decoying us from the eggs or young. This nest was on a flat peat-covered tract of country, quite three-quarters of a mile from the river and the sea, and in a wetter situation than most of the others met with; it was lined with a few sallow-leaves and lichen, although no sallow grew within some distance. The colour of the two materials agreed well with that of the eggs, and made them more difficult to detect on the tundra.

On our way back to camp, a Willow-Grouse got up from her nest. It was placed on the open ground without a particle of shelter, and she sat until we almost trod on her. There were fourteen eggs nearly chipping, and they occupied us till 7.30 that morning, as all the young had to be cut in pieces with fine scissors and removed with forceps. This nest was only a quarter of a mile from camp on a part we had repeatedly walked over, showing how close the Grouse sit, trusting to the protecting colour of their plumage. The females had now assumed entirely brown plumage, but the wings and much of the bodies of the males were still white. The above is the largest clutch I have ever found of the Willow-Grouse. We saw a number of male birds on the island, and shot one or two for the pot; but they were as wild as their congeners on a Scottish moor at the end of the season, and it was well that the food supply here did not depend on our guns.

July 9.—The 9th was another misty, raw, uncomfortable day, with cold wind from the north. We left camp in the evening to explore our bank (the south) of the Gobista. A fine Snowy Owl sat on a projecting bluff—the first I had seen in a wild state; but he declined to allow us to come within shot. Near here we found the remains of the nest of a King-Eider, with some egg-shells recently hatched, and should have much liked to come across it at an earlier date, for authentic eggs of this bird are comparatively rare. The King-Eider is common here, but no Common Eiders were seen by Mr. Trevor-Battye or ourselves.

On reaching the edge of the next bluff, Feilden and I saw two Swans below us feeding on a marsh at some distance from the edge of a lake, and with our glasses we detected some young in down accompanying them. We signalled to Slater (Charles was some distance behind), and away all three ran to cut off the cygnets, over great snow slopes, marshes, bogs, and water; it was a most exciting race, ending in a dead heat between pursuers and pursued on the edge of the lake. The old birds kept on the ground, running with their young, and urging them to increased efforts, until we were within shot, when the male flew off to a safe distance. Slater shot the female just as she was rising, and also one of the cygnets on the water; I captured a second on the bank, and Feilden a third. Our pleasure was great on examining our prizes, for they were Bewick's Swans, a species rarely met with in the breeding season. When passing this lake again on the 14th, I discovered a fourth cygnet, which had escaped us on the 9th. Taking Cash with me to secure it, we arrived on the bluff above just in time to see the old bird hurrying the cygnet towards the river in the distance, before the whole scene was shrouded in dense fog. They had left the lake, and were travelling up a long narrow piece of water which had once been part of the river-bed. Cash took one side and I the other, and cut off their retreat to the river. The youngster gave us an hour's chase before we caught him, the old male flying round us the whole time, and repeatedly coming within easy range. I believe these cygnets were the first of their species brought to England in down; two were presented by Feilden to the British (Natural History) Museum, and are now in the Swan case of the Bird gallery. Some were obtained by the Austrian Expedition in 1872 on Novaya Zemlya and placed in the National Museum at Vienna.

Continuing our walk up the river for some miles, we found another Grey Plover's nest; this was on a site of different character to all the previous ones, the bird having laid among coarse grass on the low ground, and only twenty-five yards from the river. The eggs were nearly hatching, and the young had their beaks through, calling distinctly; I could hear them several yards away. Having carefully packed the eggs for dissection in camp, we crossed a small stream (the first we had met with) and ascended the bluffs to the higher land. We were now about seven miles from camp in a direct line, and decided to turn; for the country stretching away into the distance appeared of a similar character to that we had passed over. Resting a few minutes on a bank to have some food, our eyes were fully occupied enjoying the lovely masses of gentian and other flowers around us. I think it is only in such bleak, desolate countries one learns to fully appreciate the beauty of flowers, at least no flower-show ever gave me the pleasure some of these banks in Kolguev did.

Just as we were turning for camp, we saw another pair of Grey Plovers, and watched them twenty minutes in the bitter cold; but four proved too many, and the birds would not settle, so Feilden and Slater returned. Charles and I remained an hour,—I always do this work by the watch, for every ten minutes seems half-an-hour without it—before one bird went to the nest, and then it was out of sight behind some rising ground. So we changed our position and waited yet another fifteen minutes, when we finally secured the four eggs. After that we made straight for camp, for even Grey Plovers could not detain us on the way, arriving there about 6 A.M.

July 10.—We still had the same cold, wretched weather on the 10th, with north wind, fog, and occasional rain. After breakfast, Charles and I tackled the eight incubated Grey Plover eggs, a task we shall never forget! They occupied nearly three hours; and in spite of the stove, we were so cold that our bodies were numb, while legs and arms were in a constant tremble. Even a summer excursion in the Arctic is not all pleasure. I was the most sorry for poor Cash, who had no excitement over rare birds and plants to divert his mind from his troubles, and I believe he spent as much time as possible in bed, covered by all the clothes he possessed in that part of the world; however, he never grumbled, and was a right good fellow, doing all in his power to help us.

That night Charles and I took nothing on the tundra, spending one or two half-hours on the ground without result. Feilden and Slater left camp an hour later for another attempt on the Snowy Owl. After three ineffectual efforts to get within range, Slater brought the bird down with a long shot; a beautiful old male, without a speck of colour on his body, and only a few faint spots on his wings. We two had lain watching him some time through our glasses. He evidently knew it would be useless to hunt on the wing, as his great white mass would be seen at once by his prey; so he sat beside a hillock on some high point, his body perfectly upright and motionless, with all the lower feathers somewhat spread out, forming a skirt down to the ground, and answering the same purpose. Only his head moved, and that everlastingly turned in all directions; it appeared just as comfortable over his back as over his breast. His eyes also were constantly altering their focus, as we could see by the movements of the iris. This was the only Snowy Owl we saw on Kolguev.

Mr. Trevor-Battye met with many on the east side of the island, but the Samoyeds told him that this species never bred here.

July 11.—We turned out of bed in the middle of the afternoon, only to find another miserable, cold, damp day, with more north wind. Apart from the subject of bird life, there was one great advantage in our "nocturnal" habits: we worked and walked through the coldest hours, when exercise only could keep the blood in reasonable circulation, and benefited by the few degrees the thermometer rose at mid-day in the increased warmth of the tents. I can strongly recommend our usual routine; namely, to clear up all the work remaining from the previous day between breakfast and dinner, and then start for a long tramp fortified by the principal meal of the day. In the evening we crossed to the north side, where Charles and I were fortunate in finding several nests of Little Stint and one of Grey Plover. The latter was the only one of the species obtained without a long watch, for on climbing a bluff I saw a bird rise on the sky-line, went direct to the spot, and found the nest at once within three yards. Feilden and Slater had been working chiefly among the flowers. They met with a Temminck's Stint's nest, containing three young in down and one addled egg.

July 12.—The sun shone brightly during the early morning, his first appearance for some days. In the afternoon the country was covered with snow, but it melted away in the next two hours, although its traces remained in the temperature. Leaving camp at 11 P.M., we went up the coast north of the Gobista for two hours and a half. I carefully searched the crevasses in the tundra near the shore, in hope of finding nests of the King-Eider, but met with no trace of them. This coast is being denuded very rapidly, for the bluffs, rising at their highest point sixty feet above the sea level, are nothing but glacial mud, and the frost, rains, &c., are constantly detaching large masses, which, falling down on the beach, melt away under the action of the sea, and form shoals along the coast. Three ancient fox-traps near the edge of the bluffs, arranged with a large stone on the "dead-fall" principle, told of the occasional presence here of both the animal and his Samoyed captor. We crossed four ravines, two only extending for any distance inland; all contained a large number of erratics. I noticed one five yards long, three wide, and two high above the level of the ground; it was planed off on one side as truly as if it had been under a stone-cutting machine. We secured several young in down of the Grey Plover, the first we had met with; and also saw a number of old Swans' nests, but I think only one pair have bred in the district this season. The larger birds have suffered severely since the Russians provided the Samoyeds with better guns.

I had only been asleep an hour and a half when Cash woke me to say he heard the *Saxon's* steam-whistle. I dressed at once and went down to the beach; but there was no chance of those on the ship communicating with us, for the surf was far too heavy to allow a boat to land; so she went south to get under shelter of the island. The other fellows preferred to take my word for the ship being there, and returned to slumber. Thinking our stay here would soon end, I went up the valley to look at some nests we had noticed previously. Two Black-throated Divers had added to their nest since our last visit, but still had no eggs. A Red-throated Diver had one egg containing a chick covered with down; among some dozens of nests of this bird I have taken in different countries, this was the first with only one incubated egg. Next, two Grey Plovers and I began to take a keen interest in each other; both old birds coming within thirty or forty yards, running from point to point, and uttering their alarm-note. They were shortly joined by an old Dunlin, who sat on a hillock with a self-satisfied air, and kept on repeating something which sounded very like "Told you so!" The Plovers bore it some time, but at last they could stand him no longer, and with a rush drove him off the scene. The nest contained three eggs, one chipping and two addled; it was the second on the low ground near the river.

The fog came down again in the evening, and the wind veered towards the west, a bad quarter for us. Later on there was rain and snow, enough of which penetrated the tarpaulin to form a gentle rain inside, making pools on the macintosh coat spread over the bed.

July 14.—The following morning was fine, but clouds came up over the sky at noon, and were succeeded by more fog and rain. Charles and I went up the river valley in the afternoon. Walking along the edge of the bluff, we came on two Turnstones, uttering angry cries, and evidently much disturbed by our presence. Both birds watched us lying on the tundra for a long time, running from point to point and examining us from all sides; at last, just as we began to hope for a speedy discovery of the nest, one bird flew down into the marsh near the river, and settled several hundred yards away. Immediately we saw through our glasses four little specks join it on the mud flat, and, hurrying down, secured them after a chase. Both Turnstone and Grey Plover are partial to these bluff-edges for nesting purposes, and we found far the greatest number there; for the birds, ever on the watch, can see over a large extent of country, and are thus aware of any danger long before it reaches them. When the young are hatched, it is a short and easy journey to the marshes below; one old bird takes charge of them there, while the other remains watching on the bluff above. Grey Plovers rarely breed in close proximity, each pair appearing to take possession of about a mile of country; but they do not object to the presence of Turnstones, and the alarm-note of one at once puts the other on guard. We found a ready way of locating the nests of either species was to watch a pair of Richardson's Skua hunting over the tundra, for as soon as they approached the nest, both the Plovers or Turnstones rose into the air and drove them away. I have also seen a Little Stint rise from the nest at a Grey Plover in the same manner.

In the evening Feilden and Charles walked down the coast to the south for six miles, and reached the Kriva river. On its northern shore stood a Russian cross ten feet high and handsomely carved; a long Russian inscription was cut on the back in raised letters. The river flowed through a large lake, only separated from the sea by a broad tract of sand and shingle, and behind the lake stretched an extensive tract of flat country apparently covered with grass. Nine Geese, accompanied by six goslings, were feeding near the lake, and the two goslings secured agreed with those of the Bean-Goose caught at Lutni. We only saw Geese on one other occasion; it is clear, therefore, the large numbers described by Mr. Trevor-Battye do not breed on this part of the island.

July 15.—We did not leave camp for any great distance to-day, for we expected the *Saxon*, and began to be anxious as to what had become of her since the 13th, especially as our stock of provisions was now getting low, and would only last another three days. However, all our troubles were dispelled the next morning, when the *Saxon's* whistle woke us at 7.30. The camp was alive at once. Cash got us some tea while we packed, and by the time the boats landed much of our impedimenta was ready for shipment. The men worked so well that tents, stores, and spoils were all safely on board by 10.30—very good time, for the *Saxon* lay quite a mile from the shore, and the surf was still high enough to require great care in landing. After everything and everybody had gone down to the boats, Feilden and I were engaged in a last look round to see nothing was forgotten, when a male Snow-Bunting settled on the turf wall erected to protect the tents, and sang "good-bye" to us.

A word of warning to any proposing to follow in our steps. Let them not presume on our good fortune and attempt this island of Kolguev without the most careful preparations for all eventualities; there are few more dangerous or difficult coasts in the northern seas. It lies but fifty miles from the Russian coast, yet the Russians who took off Mr. Trevor-Battye were occupied the whole of June, July, and August in accomplishing that fifty miles. A perusal of his experiences will act as a useful corrective to the impression produced by this record of our easy times.

PLATE 6 A.

ISLAND AT WEST ENTRANCE OF KOSTÏN SHAR.

PLATE 6 B.

19-7-95.

S.Y. "SAXON" ANCHORED TO THE ICE.

CHAPTER III

NOVAYA ZEMLYA

JULY 16.—We were all glad to get back to the comfort of our own cabins, a change of clothes and a hot bath; also a good square dinner. By 4 P.M. we had cleared the north point of Kolguev and set our course for Kostïn Shar.

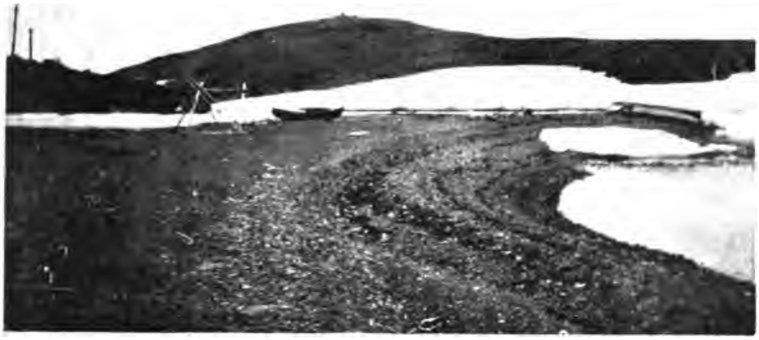
July 17.—A gale from the NNW. with heavy cross seas gave the *Saxon* a lively time during the early hours of the 17th, and still further reduced our stock of crockery. We sighted land at 1 P.M., and at 4.30 were on shore at last in Novaya Zemlya, or, to speak more accurately, on a small island off its coast. The change since we were here on July 4th was really marvellous. Then the sea was covered in every direction by one dense pack of ice, resting on the north-east coast of Kolguev, and filling the whole of the eastern part of Barents Sea. Now, thirteen days later, we steamed from Kolguev to Novaya Zemlya over a perfectly open sea, and only saw three small pieces of ice about the size of a dining-room table. In those thirteen days hundreds of square miles of ice had broken up and disappeared.

The small island in question lies at the west entrance of Kostïn Shar; but I have not clearly ascertained whether it has a recorded name. Its low cliff was occupied by a colony of Brünnich's Guillemots, which had deposited their eggs on every available ledge of the rock face. Many eggs were brought up to the top of the cliff by the aid of a "bird-nesting rod" (an invention of my friend Mr. E. Bidwell), but the bulk were collected by Morrison, A.B., who climbed over a large part of the loomery with the aid of a rope. 196 eggs were taken fit for specimens, and the majority were fresh. They varied in size from $3\frac{8}{20} \times 2\frac{1}{20}$ to $2\frac{15}{20} \times 1\frac{17}{20}$. We again visited the place on the 23rd, and took 244 more, the whole forming a most interesting series. Here were 440 eggs taken from one small cliff, laid by birds of the same species, feeding, as far as we knew, on the same food, certainly over the same area; yet the eggs varied from pure white without a spot, through all the shades of ochre and maroon-brown to the rich colours of a Razorbill's egg, through many shades of blue-green with all varieties of pencillings and blotching, and through an equal number of shades of yellow-green, to specimens as richly blotched with black as some of the finest of eggs of the Common Guillemot taken on the Yorkshire coast. This subject of the coloration of eggs is truly one of which we may be said to know nothing yet. I have seen on one small island in Norway eggs of the Herring-Gull of a beautiful red colour blotched with deeper tones of the same; others of a light sky-blue without a spot on them, surrounded by hundreds representing most of the variations usually found in those of this species. It is scarcely possible these abnormal variations can serve any useful purpose. What is the cause of them? I commend the whole subject to some young naturalist, desirous of striking out a new line for himself, as one well worthy of the closest study.

The labour of blowing, washing, drying, and marking these 196 eggs was considerable. My brother and I worked at them steadily for nine hours; fortunately we had a very good apparatus for blowing, or the time occupied would have been much longer.

Plate 6A represents two masses of rock detached from the main cliff. A fine old Glaucous Gull sat on the summit of that to the right, his attention divided between us and his larder of Brünnich's eggs below him. We took a number of eggs from the peak on the left during our visit of the 17th; when we returned on the 23rd, the rock and its remaining eggs had all vanished into the sea, and not a trace remained. The "snow foot" on the left of the picture extending from the cliff face, will give some idea of the manner in which the snow accumulates here, for this was

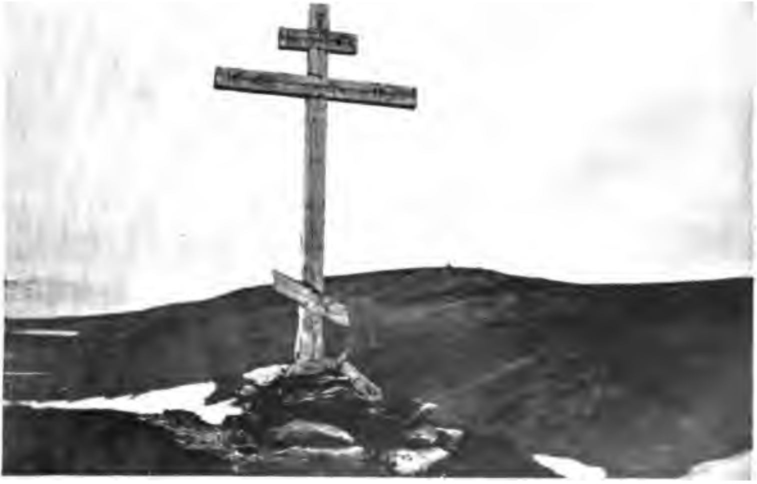
PLATE 7 A.



20.7.95.

NECHWATOWA BAY.

PLATE 7 B.



RUSSIAN CROSS, NECHWATOWA BAY.

July. The only other nest found on the island was a Ringed Plover's with one egg and three young.

A few plants struggled to maintain an existence—amongst them some lovely little clumps of *Eritichium villosum*—but not a flower on the island had a stalk an inch long, sure signs of the winds to which they are subject. After our return on board, the yacht was moved to the east and anchored in Rogatchiva Bay, a sheltered position on the north side. Feilden and Slater landed on the main island, and reported traces of reindeer; they also saw two pairs of Bean-Geese with goslings, Red-throated Pipits, Lapland and Snow-Buntings.

July 18.—Those who went on shore to-day said the country was very desolate. Feilden had seen a number of Bean-Geese with their goslings, but the old birds took care to keep just out of range. He also saw Purple Sandpipers, several Ringed Plovers, Glaucous Gulls, Pomatorhine Skuas, Kittiwakes, and a Snowy Owl. There were many Lemmings' runs and burrows, but no Lemmings. The day had been cold with a north wind, and in the evening all the small pools had a thin coating of ice. Two Black-throated Divers were on a lake, but no sign of a nest.

July 19.—Leaving our anchorage the next morning, we steamed to the east down Kostīn Shar, landing on all the small islands we passed on the way. Several of these were useless from a naturalist's point of view, for they had hardly a plant or an insect on them; while all their higher points were evenly rounded masses of decomposed slate—mud, in fact—in which splinters of slate, somewhat harder than the rest, stood up in all directions like pins on a pincushion, producing a most curious effect. We saw quite a hundred male King-Eiders in adult plumage on the sea, and hoped the females were nesting on the islands. When the first Eider's nest was found, there were considerable rejoicings; but alas! Slater shortly after shot two males of the Common Eider, proving that both species were present. Afterwards, every female was shot as she rose from the nest, only to supply us with a good quantity of fresh food and numbers of eggs of the

Common Eider, for every one belonged to that species! Where all the females of the King-Eider were, constituted a problem we never solved, although we worked hard at it. The Common Eider is a useful bird on the table, and little inferior to the Mallard; but the skin must be avoided, as it has a disagreeable bitter taste.

Some of the islands were still connected by last winter's ice, several feet in thickness. The photograph reproduced in Plate 6B represents the *Saxon* anchored to this ice; part of the foreground looks as if it were open water, but the effect is produced by shallow pools on the surface of the ice. We walked up to the yacht's side and went up the companion ladder with as much ease and safety as in a dock. In the evening we steered for the mouth of the Neckwatowa River, and, after some trouble, found a well-sheltered anchorage behind a small island, the one occupied by Von Heuglin in 1871. The fog had been threatening us all afternoon, but fortunately kept off. After dinner, Charles, Kjeldsen, and I landed on the island close by. There were more new Eiders' nests on it than on the whole of the islands visited during the day; yet only one nest contained eggs, and this on July 19. A pair of Glaucous Gulls had their nest on a pinnacle of rock projecting from the east cliff on the island. Although the rock was very rotten and unsafe, Kjeldsen climbed down some 30 feet, then mounted the pinnacle and secured the three young in down. Two of these at once became the pets of all on board and lived to reach England. My brother had the larger one, named "Nova," and kept him for twelve months; but unfortunately in the autumn of 1896 he developed a taste for the berries of the deadly nightshade, and they quickly sent him to the "shades" of gull-life. "Zemie" is still alive on my lawn, with other gulls from the north, and is a constant source of amusement. The changes in her iris and plumage have been very interesting; the former began to take a lighter colour in the autumn of 1896, and the feathers lost much of their brown markings during that moult. In the spring of 1897 the iris became a clear yellow; and by the autumn of that year she had a grey mantle and white

PLATE 8 A.

NECHWATOWA RIVER AND WILCZEK LAKE. 20-7-95.

PLATE 8 B.

NECHWATOWA RIVER.

breast, although the brown markings were still retained on the wings, and slightly on other parts of the body. Now (February 1899) she is in full adult plumage. Two Great Black-backed Gulls, also taken from a nest in Norway in 1895, had practically assumed adult plumage in the autumn of 1897, twelve months before they are supposed to do so in a wild state. They showed a strong desire to commence the construction of a nest last year, but eventually decided to postpone it. The irides of these birds are now a deep red, and not yellow as some bird-stuffers make them. Three other Glaucous Gulls, brought home in 1897, complete the party; one, larger in size than "Zemie" or the Black-backs, has changed his mantle to the mature grey, but retains the dark colour of the iris seen in the bird of the year; another smaller bird assumed the yellow iris last summer, and the third is now rapidly changing the iris to yellow, but neither of the latter two show any sign of grey in the plumage.

Having carefully walked over the island, we crossed to the mouth of the river. An illustration of this place is given in Plate 7A. The Neckwatowa flows from the left in front of the great snow-foot in centre, and enters the sea on the right. A number of Russian crosses, 10 to 12 feet high, will be seen on the left, and others stood farther up the valley; these are votive offerings erected in thankfulness for delivery from all the perils of Barents Sea, and most of them are carved with rude symbols. Two old Russian boats were there, long past use, and beside them stood some poles for fish-drying. Farther up the river were the remains of a small Russian bath-house, and a large collection of old fishing-gear, poles, drift-wood, &c. Continuing our walk up the river, which is here about seventy yards wide, we shortly came to Wiltschek Lake, a large piece of water, but very shallow over the greater part of its area. Thirty yards from the south-west shore were the last fragments of an old hut placed on a dry knoll, built of logs laid horizontally and notched over each other at the corners. It had measured 15 feet by 16 feet (as indicated by the two last remaining logs *in situ*), and was divided by a partition four feet from one side; in the smaller compartment were the remains of a fireplace, made of bricks composed of clay and sand, and measuring 11 inches by 5½ inches by 2½ inches, a size unusual in Western Europe. There were also several large stones, much calcined, showing the hut had been used some time. Of course ruined huts are often met with in these northern countries, the temporary homes of hunters and fishermen; but this could have unfolded a sad tale, as eight skulls, probably belonging to some of its inhabitants, lay a few yards off. One of the skulls was a well-developed square one, with the teeth in good order; the others were of a lower type, with receding foreheads, and from the state of their teeth we thought they had probably died of scurvy. Some were partly covered by stones, others lay on the surface; most likely they had all been disinterred by some hungry ice-bear.

Quite a hundred Long-tailed Ducks, two male King-Eiders, and a large Diver were on the lake. The last was *Colymbus adamsi;* I saw its yellow beak most clearly through my glasses.

We walked round the south-west side of Wilczek Lake to the river, and followed it until we obtained a good view of the great Lake Neckwatowa stretching away to the horizon, when we turned over the hills for the ship. The ground here was very bad, and largely composed of what we at once named "stone bogs," areas of considerable extent covered with stones from the size of an orange to that of a walnut, and looking like a new road made under a careless surveyor; yet directly you stepped on them, both you and the stones sank into eight or ten inches of soft mud. Four Glaucous Gulls and two Ringed Plovers were the only birds seen after leaving the smaller lake.

July 20.—Our description of the previous night's walk caused a general desire to explore Neckwatowa Lake; so the whole party left the ship in the cutter at 11 A.M., accompanied by five of the crew. Stopping at the old hut, we carefully buried the eight skulls under a large heap of stones, and re-erected a cross which lay near.

PLATE 9 A.

SOUTH END OF NECHWATOWA LAKE.

PLATE 9 B.

MALTZAN ISLAND, NECHWATOWA LAKE.

20-7-95.

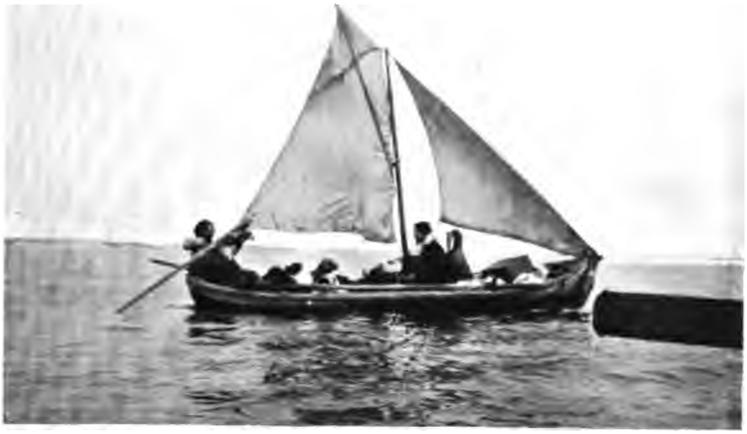
Of course the photographs of the scene were all failures. Those you specially want always are. Three Bean-Geese were shot here that had just moulted their quill-feathers, and as the boat was already well loaded, they were left on a rock till our return:—a mistake, for the Glaucous Gulls appropriated the greater part of two.

The stream between the two lakes ran swiftly, making it such heavy work for the rowers that some of us walked up the bank. Great snowdrifts many feet in thickness still adhered to both banks; and I have no doubt that after the river freezes in autumn, the snow fills up its course to the level of the surrounding plain. Neckwatowa Lake is a fine sheet of water, ten miles long and two to three wide; and is surrounded by an undulating country covered with a little coarse grass and moss, interspersed between the "stone bogs" described above. Rejoining the boat, we pulled up to Maltzan Island, which contained two pairs of Snow-Buntings and a few plants. While we had been learning these important facts the men were engaged in dragging the boat over a belt of ice 200 yards wide, 5 feet thick, and extending from shore to shore. If it is remembered that this was in the third week of July, usually one of the hottest parts of the summer, it will convey a better idea of the climate of the country than pages of description. We next rowed up to Klein Island, the largest on the lake, and rising 100 feet above the water. There were some beautiful banks of flowers surrounding the spot selected for luncheon, and the island was generally greener than much of the neighbouring country. Bird-life, however, was very scanty, and the only nests found were those of two Common Eider, each containing five eggs. Three fine erratics were perched on the highest point of the island. Standing beside them, we saw in the distance another long, low island—Schmidt Island—stretching some distance across the lake; but on rejoining the boat, it had disappeared below the waves, showing its slight elevation and distance from Klein Island. On landing there, it looked just the place for duck to breed on; but alas! they did not agree with our view, for only one nest of the Common Eider was found. It contained five eggs, and when I collected the down under them, I noticed the duck had most cleverly secured it in position with many stones placed round the outer edge of the nest. I have never met with a similar case.

During our visit to Iceland in 1894, my brother and I had always found the islets in the lakes far the richest spots in oological results. Judging from this experience, we felt convinced, when studying the maps of Novaya Zemyla, that if we could only reach these islands in Neckwatowa Lake, many rare eggs would reward us. And when at last we got there, it was to find three nests of Common Eider! Two or three Purple Sandpipers were the only other birds on the island, but many Long-tailed Duck, female Eider, and some Goosander were on the water near. The ice appeared to have left the two upper islands quite long enough to prevent the foxes from the mainland disturbing the birds.

Schmidt Island had much the appearance of an old moraine, brought down by some glacier from the mountains we could see in the distance, and afterwards denuded by the storms of the lake. It was composed of many varieties of rock, the chief constituent being slate; these were piled up in fantastic shapes, where large masses of ice had been driven up the beach and afterwards melted. Kjeldsen again visited this lake in 1896, when the party had the advantage of a steam-launch. He told me that they penetrated to the head of the lake, and found the river running in there too shallow for even a rowing boat. He saw another lake beyond, bordered on one side by steep cliffs and hills. During our passage up the lake the wind had increased considerably, and now took us back at a good pace; in fact, both wind and water were nearly as much as the boat could stand. Passing under the lee of Klein Island, we soon reached the ice; and also ran into a dense fog, preventing our seeing half a mile in any direction. The boat had just been safely conveyed over the ice and launched on the other side, when Morrison took it into his head to

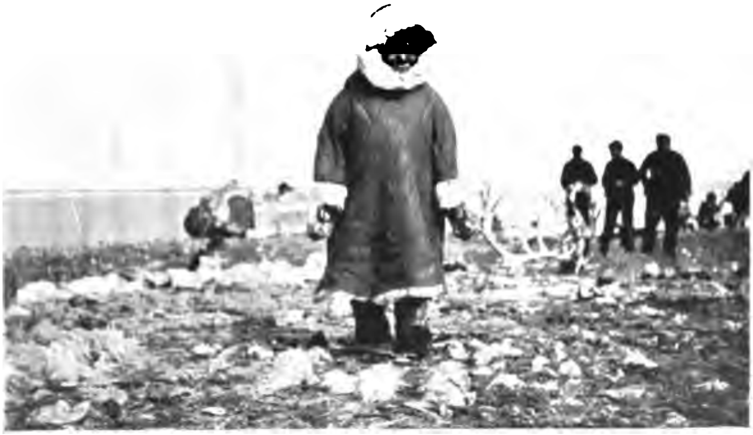
PLATE 10 A.



26-7-95.

SAMOYED BOAT, BELOOTCHIA BAY.

PLATE 10 B.



26-7-95.

SAMOYED GIRL.

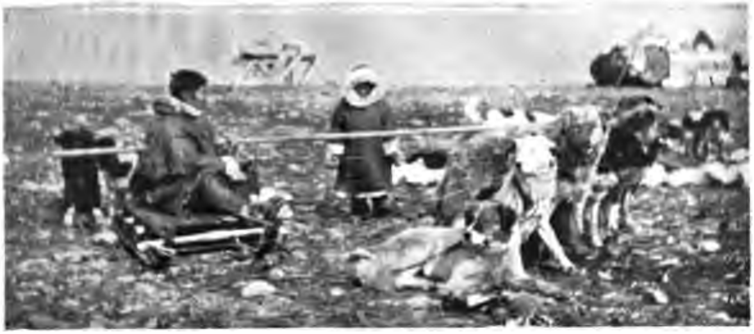
jump on a small floe—he was always up to some mischief—and came to grief, for the floe promptly turned over with him. The changes of expression passing over his face as he sank into that ice-cold lake were wonderful! He was brought back on the ice by help of a rope and a boat-hook, and I must say the first thing he did when safely landed was to have a good laugh at his own plight. Not a very pleasant position though, six or seven miles from the ship, a half gale blowing, thermometer about 30° (certainly freezing), and a cold fog. The men stripped everything off him but his shirt; that they wrung out fore and aft; it really was a ludicrous sight from our point of view. They made a collection of clothes, wrapped him in a tarpauling, and set him to row. I also administered a good dose of whisky and rum in equal proportions. From there to the ship he did row in a very different fashion to that in which he sometimes "stirred his tea" on the outward journey.

The heavy wind had so packed the loose floes up to the main ice during our absence, that we were an hour working through some 400 yards of them, with five men accustomed all their lives to ice. This will give some faint idea of the difficulties to be contended with in boat navigation amongst heavy ice on the open sea. That voyage back was very cold; my hands were so numb I could not load my pipe. It was over at last, thank goodness; for we reached a fire and dinner at 10 P.M. I was just well settled in my first sleep when I felt Kjeldsen's hand. "Mr. Pearson, there are Rein on the shore; will you come?" "No, Kjeldsen, not for all the Reindeer in Novaya Zemlya." Feilden equally emphatically declined the invitation, but kindly lent Kjeldsen his rifle. Slater, however, having more youthful enthusiasm, rose at once. He woke me at 6 A.M. to say that, after a long tiresome stalk, the luck fell to him, for the deer came his way, and he secured two. These were the only Reindeer shot during our voyage, and they provided us and the crew with a most welcome change of food after the American canned meat we had been eating. All other foods are now so well preserved that they are nearly equal to fresh; but I have never yet met with any meat preparation which was acceptable after eating it daily for a week.

July 21.—The day was cold and frosty, with snow later. After divine service Charles and I crossed the river and walked up to Neckwatowa Lake, then followed its south shore to the mouth of the Paredi River. We saw three reindeer in the distance with very fine heads; but all the horns were yet in the velvet, and I expect it is rarely possible to obtain a clean head without stopping through the winter. The Paredi is a small river running out of Rawlinson Lake, a sheet of rather shallow water and over a mile in length. On the lake were a number of Long-tailed Duck—quite the duck of the country—and along its beach was the recent track of a fox, doubtless looking after the duck. Passing the head of the lake, we came to the foot of the Whymper Chain, a range rising to some 2000 feet and largely covered with old snow. The country passed over had a very scanty supply of flowers and birds. Of the latter we only saw a few Purple Sandpipers and Snow-Buntings, four Bean-Geese accompanied by five goslings, two Red-throated Divers, and a young Shore-Lark. The snow was now coming down rather thickly, and had covered the whole country with white, so we struck across some rolling uplands—rising to 350 feet and consisting chiefly of "stone-bogs"—to the Richard Andrée hills, and so made our way back to the *Saxon* at 1 A.M.

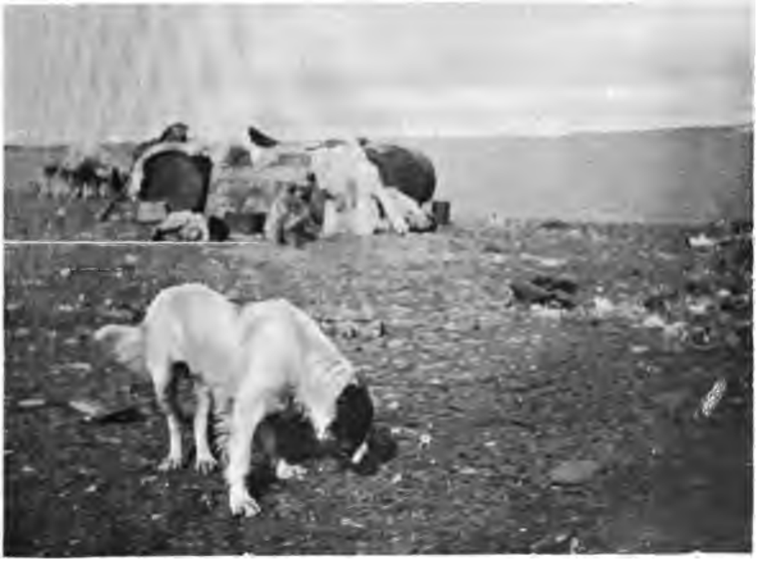
July 22.—Feilden and Slater went up the river to fish; they caught four *Salmo alpinus* in spite of dreadful weather; one weighed 3¼ lbs., and its stomach was gorged with shrimps. The Neckwatowa River is far the best place for fishing I have visited in either the south or north islands of Novaya Zemlya. The fish—chiefly *Salmo alpinus*—are so abundant, in a good season, that the Russians often catch enough with their nets in a few days to fill their small ships. It is related that on one occasion they had so hastily prepared their catch, it shortly became too rotten for even a Russian's consumption; so, returning the whole to the sea, they went back to the river, and were able to obtain another full cargo before the season closed. *Salmo*

PLATE II A.



SAMOYED DOG-SLEDGE.

PLATE II B.



26 7-95.

SAMOYED DOG.

alpinus is a very good fish for the table, though scarcely equal to an Icelandic char or a Severn salmon. Our friends recorded two fresh birds to-day, namely, a Sea-Eagle and a Dotterel; the latter was a remarkably handsome bird, with more light buff about her back than I had seen before. The wind fell, but the rain increased, and we experienced the first thoroughly wet night since we came into the Arctic.

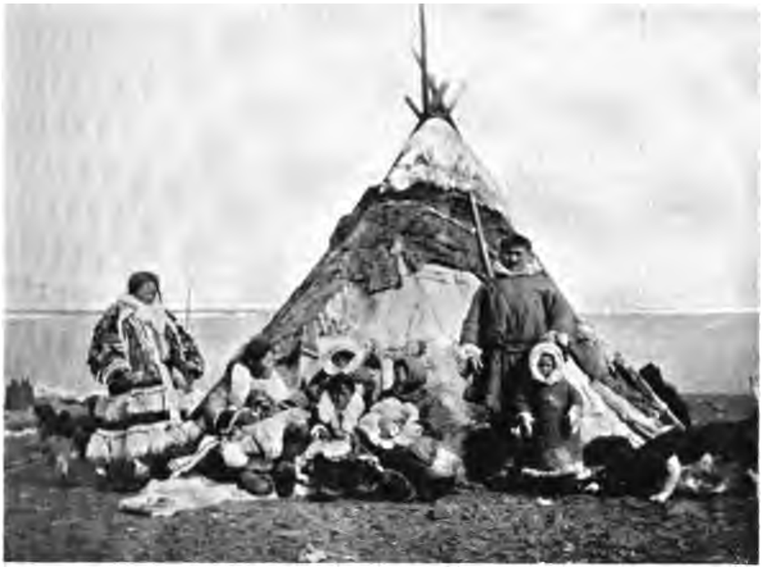
July 23.—Leaving our anchorage at 11 A.M., we steamed to the north-west through Kostïn Shar, calling at several islands with little result beyond the Brünnich's Guillemots' eggs previously recorded. At 10 P.M. we anchored (3½ fathoms) in Belootchia Bay, three-quarters of a mile from the east shore, and some four miles from the entrance of the bay, a dangerous and exposed position in a gale from any points between south-east and south-west. This bay has no good anchorage, and all the upper part is far too shallow even for a little vessel like the *Saxon*.

July 24.—The next day, aided by a good south wind, we started in the cutter at noon to visit the upper parts of the bay; stopping to walk over three small islands which lie just at the point where the bay narrows into an estuary. On the two first were several nests of the Common Eider, and one of the Snow-Bunting with two fresh eggs. The third island was larger, and rose to a height of 90 feet. As I crossed the summit a Dotterel got up just in front from a nest of three eggs, the first taken in this country, I believe. After sailing eight miles from the ship, we landed and walked four miles farther up the east bank, when we were stopped by a stream rather too deep for those without wading-boots. At this point the water was fresh and the river 100 yards wide, so we concluded it was a stream of some length and magnitude; conclusions much altered by subsequent investigations in 1897. A White-fronted Goose was shot here; it had recently moulted its quill-feathers, and could not fly. On the return journey I took a line to the east of the river, and found an undulating country with many lakes and tarns, and covered with far more grass than we had seen in the district round the Neckwatowa River; a splendid place for reindeer before the Russians planted their colonies of Samoyeds here. During our walk we counted eight dead reindeer, most of them young ones, with thick winter hair and small clean horns. The preserving powers of this pure, keen, northern air are wonderful, for although all these animals had been dead some months, and several were much eaten by the maggots of a species of fly, there was scarcely any perceptible odour, even when we turned them over. None of these dead animals had been touched by a fox or other beast of prey.

Of birds, the Snow-Buntings were numerous as usual, Ringed Plover, Purple Sandpiper, and Shore-Larks fairly common; a few Snowy Owls and Swans were seen. A thick fog, which came on before we reached the boat, caused us some difficulty in finding the ship, and it continued all the next day.

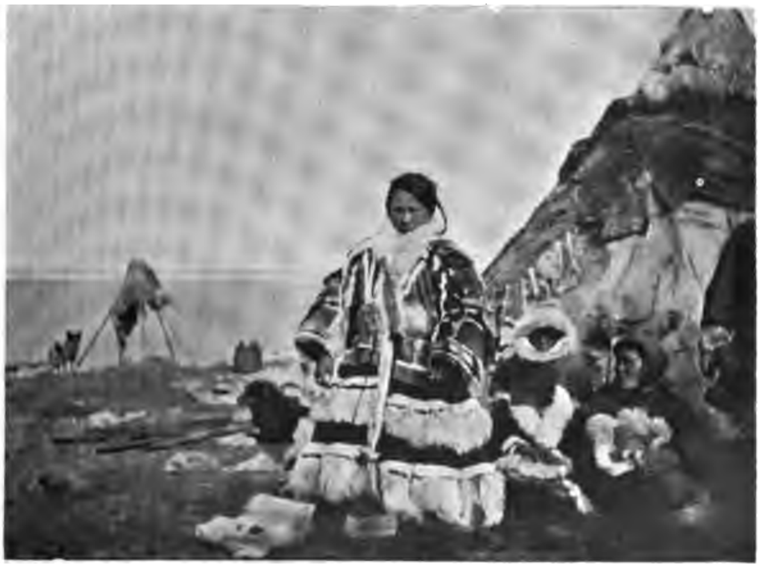
July 26.—Feilden and I left the ship early to visit the Samoyed encampment on the west side of the bay. As we neared the shore the boat shown in Plate 10A passed. It was laden to the gunwale with all kinds of gear, besides its living occupants, two men, a woman, some children, and many dogs. The party were crossing the bay to hunt on the east side; and their boat was evidently Russian built. The Samoyeds on shore showed no undue curiosity about us, and all continued their occupations, except one woman, who seized a long pole and prevented a large tribe of dogs from giving us too warm a welcome. We afterwards found she was the wife of the head man of the settlement, and named Taitiana—that was the most correct rendering we could obtain. Having shaken hands with her husband, who had small, well-shaped hands with long tapering fingers, a conversation was carried on with him through one of our men, who knew Russian slightly. In addition to the party we had seen in the boat, there were five other men up the river we had visited the day before, who had gone there to catch fish. In camp were three women, a girl of sixteen, and several children. He said that during the

PLATE 12 A.



SAMOYED CHOOM, BELOOTCHIA BAY

PLATE 12 B.



SAMOYED GIRL IN HER "BEST DRESS."

26-7-95.

summer they slept in the choom shown in Plate 12A. This was a circular tent made of reindeer skins supported by some light poles, and was about fifteen feet in diameter; in this the whole party slept when at home—fifteen at least! In the winter months they lived in a very rough hut made of logs, and brought over from Russia; it is illustrated in Plate 13A. The hut measured 30 feet by 11 feet and was 8 feet in height; the roof was nearly flat, and covered with all descriptions of lumber, amongst which were the horns on Plate 14. These reindeer horns are the finest I have seen, nor have I met with a description of larger. The weight of the head as shown is 18½ lbs. The larger of the two front horns, or snow-ploughs, A, measures 16 inches from tip to tip, its fellow 11½ inches. The horns above, B, 11 inches; girth at C, 6½ inches; greatest width between antlers at D, 33 inches; from base to tip of antler, 49 inches. The original owner of these horns had been shot the previous winter near the settlement.

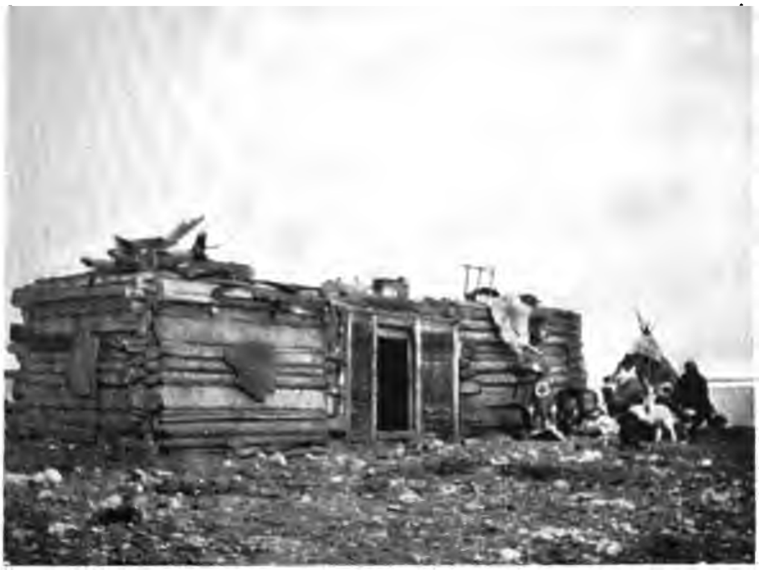
And now a word as to the ladies of the party. The girl in the centre of Plate 12B was pleasant-looking, although of a slightly Asiatic type of face; but the older women could by no stretch of imagination be said to have the slightest pretence to good looks, even when they smiled. All I can say for them is, I have seen uglier women, both Samoyeds and others. It was clear the camera was no new invention to them, for they immediately grouped themselves to be taken, and the girl vanished into the tent, from which she shortly reappeared arrayed in the costume shown. This was a wonderful affair, made chiefly of the finer summer-killed skins of the young reindeer, which had been prepared and softened in the usual way, namely, by chewing! The deep white bands round the skirt are narrow strips cut from a skin in full winter coat, and give a good idea of the length of the hair here at that season. I have never seen hair approaching this length on winter skins of the reindeer from the extreme north of Norway. The white lines on the upper part of the dress are tags of red, yellow and green cloth. The whole dress is not one perhaps to introduce into England, but it gave a general effect of harmonising with its surroundings. The work-a-day dress of the Samoyed, male and female, is, however, prepared with the skin outside and the hair inside, as will be seen in that of the little girl in Plate 10B; the white round her hands, face, and skirt is the fur naturally turning over the edges of the skin. The numerous patches of white on the ground in this and other pictures are chiefly scraps of reindeer hair; the only fragments, in that mass of refuse covering the whole area round the house, which photography has prominently reproduced. The mixture of every abomination, caused by an utter disregard of all cleanliness and sanitation, was dreadful to the eye, and in any other atmosphere it would have been equally distressing to the nose.

The Samoyed harnessed a team of dogs to his sledge, as depicted in Plate 11A, and gave us an illustration in the art of driving them. They certainly took him a splendid pace over the ground, and are able to maintain a more sober one for considerable distances. Reindeer are never used for this purpose in Novaya Zemlya, nor have the Samoyeds any tame ones there. There were some nice-looking fellows among the dogs, but they seemed a wonderful mixture of breeds, some being like the Newfoundland, and others approaching more to the type we usually regard as the sledge-dog of these Northern races—prick ears, bushy coat, and curling tail.

We bought the horns, a few skins, and other trifles. On departure I presented a small pocket-knife to the man, and he conveyed his thanks by a little extra pressure in his final hand-shake as well as any Englishman could do. Both his reception and adieu hand-grasps were specimens of the fine art. It is only fair to say I have met many Samoyeds since, but not one his equal.

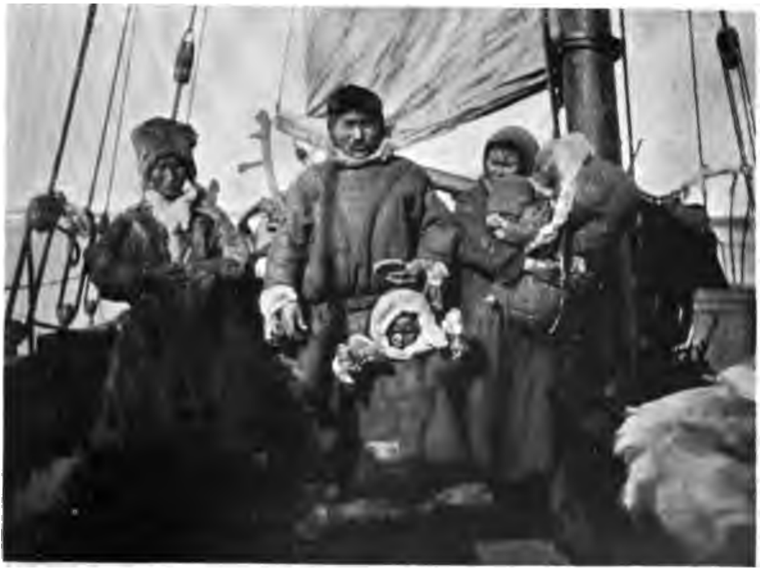
The man, accompanied by Taitiana, another woman, and the child, followed us in their own boat to the *Saxon*, and were entertained with some biscuit, &c. Our deck-house had two large panel

PLATE 13 A.



SAMOYED WINTER HUT, BELOOTCHIA BAY.

PLATE 13 B.



26-7-95.

SAMOYEDS ON BOARD S.Y. "SAXON."

mirrors opposite to each other; the women's astonishment at seeing themselves reproduced on either hand was most amusing; they ran outside several times to examine where the pictures came from. We gave them a supply of tea, biscuit, butter, and all the thread and needles we possessed.

These Samoyeds are brought over by Russian merchants, and left there during the winter to hunt the ice-bears, reindeer, and other animals, when their fur is in the most valuable condition. Having established his colony and provided some description of log-house for protection from the cold, the merchant returns to his home in Northern Russia for the winter, and remains there till summer is sufficiently advanced to have cleared the sea of ice. As soon as he considers that navigation is safe, he sails to the north again, taking supplies of biscuit, tea, ammunition, &c., which he exchanges at prices fixed by himself for the skins and other produce of the chase obtained during his absence. Unfortunately vodki also largely enters into these bargains at times. Although I believe that men like Ivan Alexandrovitch of Habarova deal fairly with the Samoyeds, the system is manifestly open to the gravest abuse; but it would not be well to repeat various things told to us on this subject, because we never heard the other side of the tale.[1]

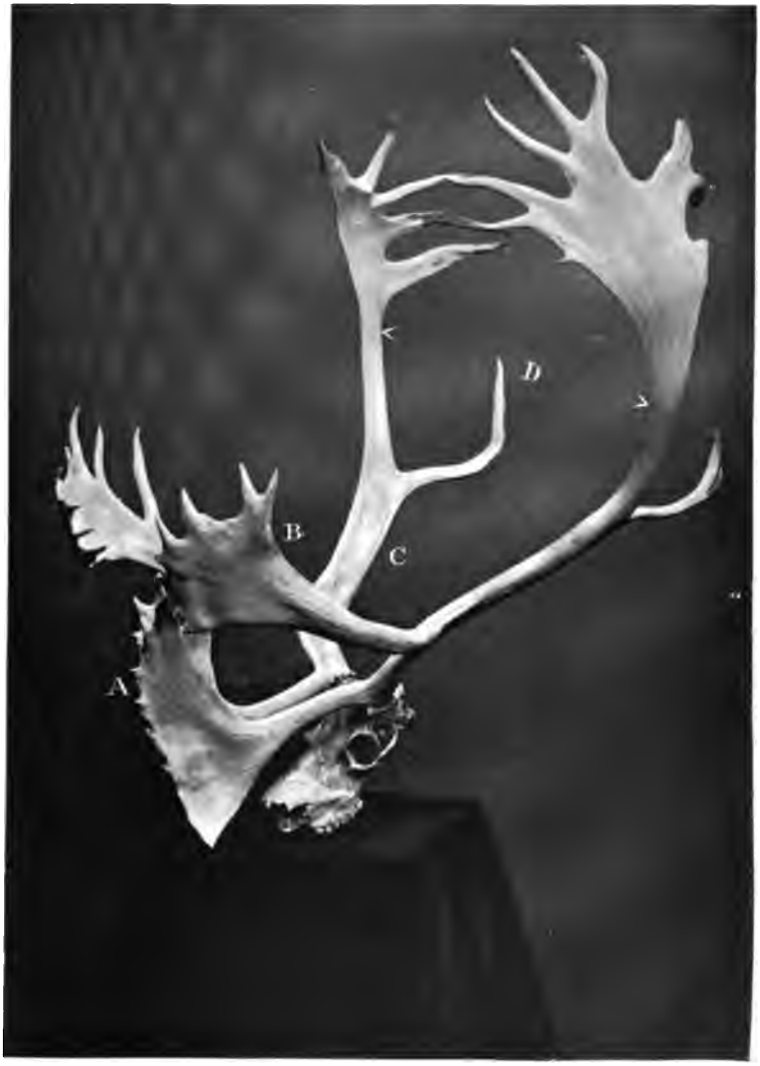
Finding that my brother and Slater had gone to the east side of the bay, we had some lunch, and took Kjeldsen with three men to the west. We rowed some miles up the bay to avoid the ground constantly disturbed by that hungry pack of dogs at the settlement. Kjeldsen's feet were sore, making him glad to remain in charge of the boat. Striking inland due west, we walked three hours towards a range of hills we wished to examine. The first part of the ground we passed over was far the best pasturage we had seen in the country, or in fact since we left Norway. It was a series of gentle undulations, and drained by several small streams running into the bay. We saw four Swans feeding, and got within a hundred yards,

[1] Please note last paragraph of Preface.

obtaining a good view through our glasses, from which we believed them to be Bewick's Swans. Several Snowy Owls were on various points of observation, and we saw two or three of their old nests, but none showed any signs of having been used this year. We noted also Purple Sandpipers, Ringed Plovers, Shore-Larks with young, Snow-Buntings with young, and three Geese, which were thought to be White-fronted. As we advanced the grass became scarcer, and gave place to "stone bogs," useless to bird or beast, and affording the worst ground possible for travel. This, and the fact that the hills now proved too far off to be reached in any reasonable time, decided us to return; and it was well we did so, for we were shortly after enveloped in a dense fog, which wetted us almost as thoroughly as a Scottish mist. Steering back by the compass and wind, we made a good "land-fall," hitting the coast within 100 yards of our starting point. Fortunately we knew ourselves to be between two rivers, and had little cause for anxiety as long as we did not cross them. Careful old Kjeldsen had noted the fog coming on, and fixed two stones giving the bearings of the ship, so we had little difficulty in crossing the two miles of water to her; still we were glad to hear the *Saxon's* bell, and more pleased to find dinner nearly ready, for it was 10 P.M.

July 27.—The anchor was up early, and we started for "home" at 8 A.M., with a strong south-east wind and short choppy seas. When rounding the south end of Goose-Land, we had a narrow escape from shipwreck on a reef situate about one and a half miles SSE. of Podvezoff Island.

During the remainder of this and all the following day we passed through a very rough time. The wind worked round to the west till it was dead ahead, obliging us to go at quarter speed. Great rollers constantly struck the ship, making her quiver from stem to stern, and rising over the bulwarks, swept the deck with floods of water. On the 29th the weather moderated, and we were able to make better progress, so that we landed in Vardö at 10 P.M.



REINDEER ANTLERS.

BELOOTCHIA BAY, NOVAYA ZEMLYA, 1895.

on the 30th, arriving there with 5 cwts. of coal in the bunkers, a margin quite small enough to be pleasant on a ship with so little sailing power. Leaving there the next day, we steered for Hammerfest, where our letters and a bundle of newspapers awaited us in the care of Mr. Robertson, the British Vice-Consul.

The remainder of our voyage down the Norwegian coast calls for no comment. We arrived at Bergen on August 9th, and that night slept for the last time on board the *Saxon*. We parted the next day from her and our crew with sincere regret, for while she was totally unfitted by her small coal-space for our voyage, she had proved a staunch little vessel under many trying circumstances, and had given us very comfortable accommodation. Our crew, too, were right good fellows on the whole, and had served us well; all had been active, willing, and attentive, both on board and on land, and we were signally fortunate in having obtained ten such trustworthy men, of whom we had previously known nothing.

CHAPTER IV

ARRANGEMENTS FOR 1897

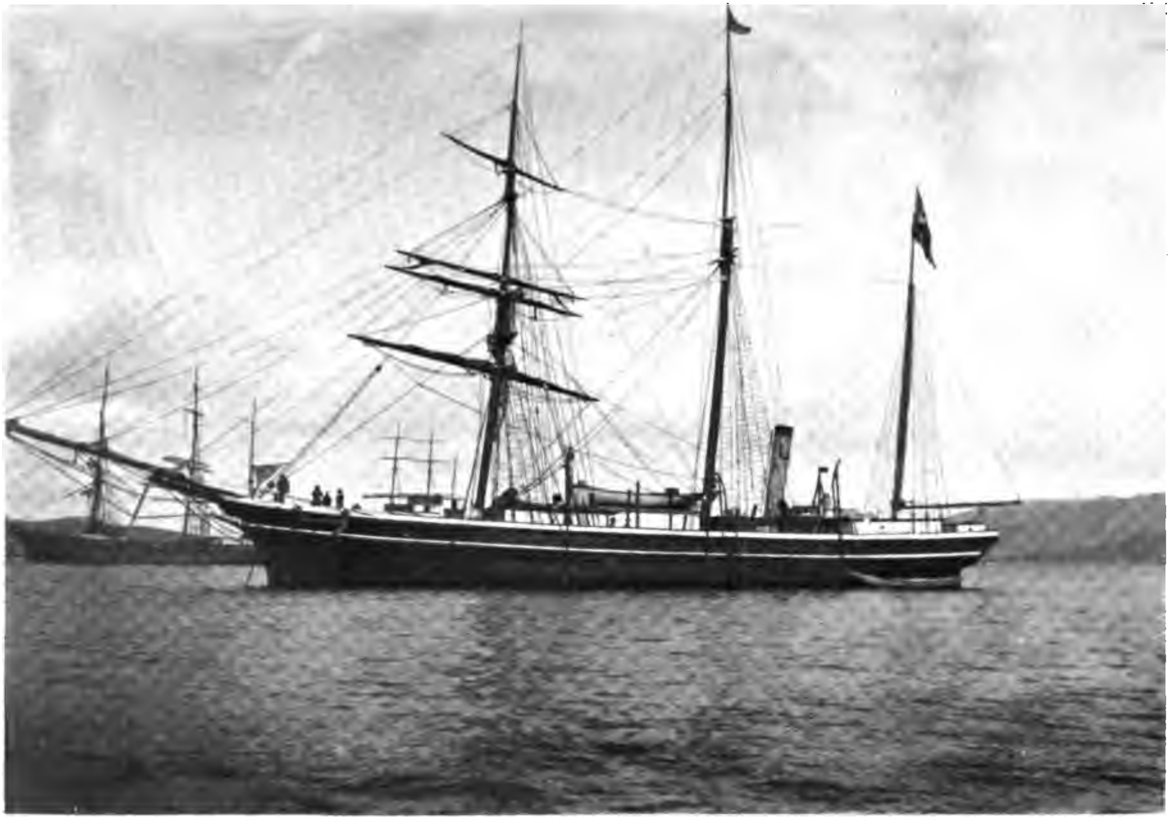
ALTHOUGH the expedition of 1895 had largely failed in its original object, owing to the condition of the ice and the unsuitableness of our vessel, much information and valuable experience had been gained, and the "Arctic fever," which generally attacks those who have spent even a summer in the north, obtained a firmer grip over one of its victims.

Circumstances prevented my doing more in 1896 than a short tour round the islands in the north of Norway, but the opportunity was taken of making further inquiries respecting a ship and men fitted to contend with the difficulties of navigation in the eastern parts of Barents Sea.

The preparation of an article for *The Ibis*, on the ornithological results obtained in 1895, necessitated constant reference to the maps and charts of the parts then visited; and while studying these I was struck with the apparent suitability of that north-eastern corner of Russia lying between the river Petchora and the Ural Mountains for the northern species of birds, especially the waders.

This wide extent of tundra-land, known as the Country of the Samoyeds, and called by the Russians the Bolshaia Zemelskya Tundra, bounded on the north by Barents Sea and extending far south into the government of Archangel, is practically uninhabited. In summer it is traversed by families of Samoyeds, in those few parts where the mosquitoes will allow them and their reindeer to exist; and there are some permanent fishing stations scattered along the shores of the ocean from the mouth of the Petchora to the Straits of Yugor. The majority of these people, in their annual movements from west to east

PLATE 15



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S.S. "LAURA" IN TROMSÖ HARBOUR.

in the spring, and during their autumnal return journey, follow the well-known track near the sea-shore from Habarova to the Russian towns in the valley of the Petchora. Mr. F. G. Jackson, who accompanied a party of the Samoyeds on their return from the Yugor Straits in 1893, has given us a vivid account of the country when covered with the winter snow, but we must turn to the volumes of the celebrated botanist A. G. Schrenk for a fuller description of this little-known region.

As regards the subject in which I was specially interested, neither of these authors gave much information; for almost all the birds had left when Mr. Jackson crossed the tundra, while Schrenk's attention was devoted to the plants, and his pages only yield here and there a glimpse of the birds he met with. Still it seemed impossible to doubt that those immense mud flats—shown by the charts—bordering the coast round the whole of Khapidirsh Bay, and extending many miles to the westward, must form the feeding-ground of great flocks of waders, ducks, and geese; in fact, combined with the large marshes thickly studded with lakes and tarns in their rear, they appeared to be a perfect paradise for birds. Many rivers, some of considerable size, such as the Karataikha and Khapidira, flow through the country into Khapidirsh Bay and the adjoining sea; while between them are large tracts of rolling tundra interspersed with marshes. Again, within ten miles of the head of the bay there stretches a long range of hills, the Esapeda Mountains of our charts, which reach an altitude of 400 to 500 feet, and ought to vary the character of the breeding-ground. Thus in a comparatively small area round Khapidirsh Bay are brought together hills, dry tundra, marshes, lakes and rivers, apparently providing suitable nesting-spots for many of the Arctic species.

The chief line of spring migration to this district is probably up the valley of the Volga, but smaller streams of birds doubtless come from the west of Europe, and a few stragglers may reach it from east of the Ural Mountains; so that I hoped to meet with a large variety of species, even possibly to find a pair of Curlew Sandpipers there!—

although I ought to say that this hope was discouraged by all my ornithological friends.

Here then appeared to be a most interesting corner of Europe ornithologically unknown, and I determined to visit it during the summer of 1897 if possible. Of the two routes, that by land was at once rejected on account of the long absence it involved from England. The country between the Petchora and Habarova is of so wet a nature that it can only be crossed when the rivers and marshes have been made solid by frost, and this would necessitate leaving England in February, so as to join the Russians at Pustozersk in time for their migration to Habarova before the spring thaws commence; while there could be no return until the land was again frozen and coated with snow in October.

Only the sea-route, therefore, remained, and that was beset with a thousand difficulties of ice, &c.

Knowing from my experiences of 1895 how unlikely I was to find a ship in England, I directed my attention to Norway, and at last chartered through Herr Giæver, our British Vice-Consul at Tromsö, a vessel that I believed would prove suitable for the voyage. She was an old sealing-ship of about 160 tons register, and had a hull strong enough to stand any of the ordinary ice we were likely to meet with in Barents Sea. Her rig had been altered from a brig to a brigantine when the engine and boiler were put in; this did not improve her sailing powers, and her speed under steam was only about five knots in calm weather. Still speed is not of the same importance in Barents Sea as when crossing the Atlantic. Our captain was Johan Kjeldsen, and he engaged the remainder of the crew, all men from Tromsö accustomed to sail in the northern seas. As I shall have much to say respecting them in the course of my story, it is unnecessary to add more at present.

Alas! a greater trouble than the selection of a ship now befell me. My brother, the companion of so many pleasant expeditions, had just fallen a victim to matrimony, and his days for long absences from home were over for the present. A tried companion is not easily replaced.

Colonel Feilden accepted the invitation to accompany me again, and, entering into the work with his usual energy, gave most valuable assistance in the necessary preparations. The third member of our party was Mr. Frederick Curtis, a medical student at Guy's Hospital, and one of a family renowned during several generations for the good work done in botany and other branches of science. He proved a valuable acquisition in every respect, thorough and untiring in his work, and a most pleasant companion.

Before concluding these remarks on the object of the voyage and the preliminary arrangements for it, I beg to express our deep sense of obligation to the Foreign Office, and to our Ambassador at St. Petersburg, Sir N. R. O'Conor, for the recommendation of my party to the Government of His Imperial Majesty the Tsar; and to His Excellency Count Goremykine, the Minister of the Interior, for providing us with a special passport, placing us under the benevolent protection of all Russian officials and others whilst prosecuting scientific investigations on the northern coasts of European Russia. We were also deeply indebted to M. Jules de Shokalsky, one of the secretaries of the Imperial Geographical Society of Russia, who obtained much valuable information for us respecting the overland route, at considerable personal trouble, and did all in his power to further the interests of our expedition. I have great pleasure in conveying our warmest thanks to him and other kind Russian friends for their assistance.

But, with all our preparations, we were never able to reach the land from which we had hoped so much, and it still remains an unknown corner on the ornithological map of Europe. Why we failed will be found in the following chapters.

CHAPTER V

OUR VOYAGE TO WAÏGATCH

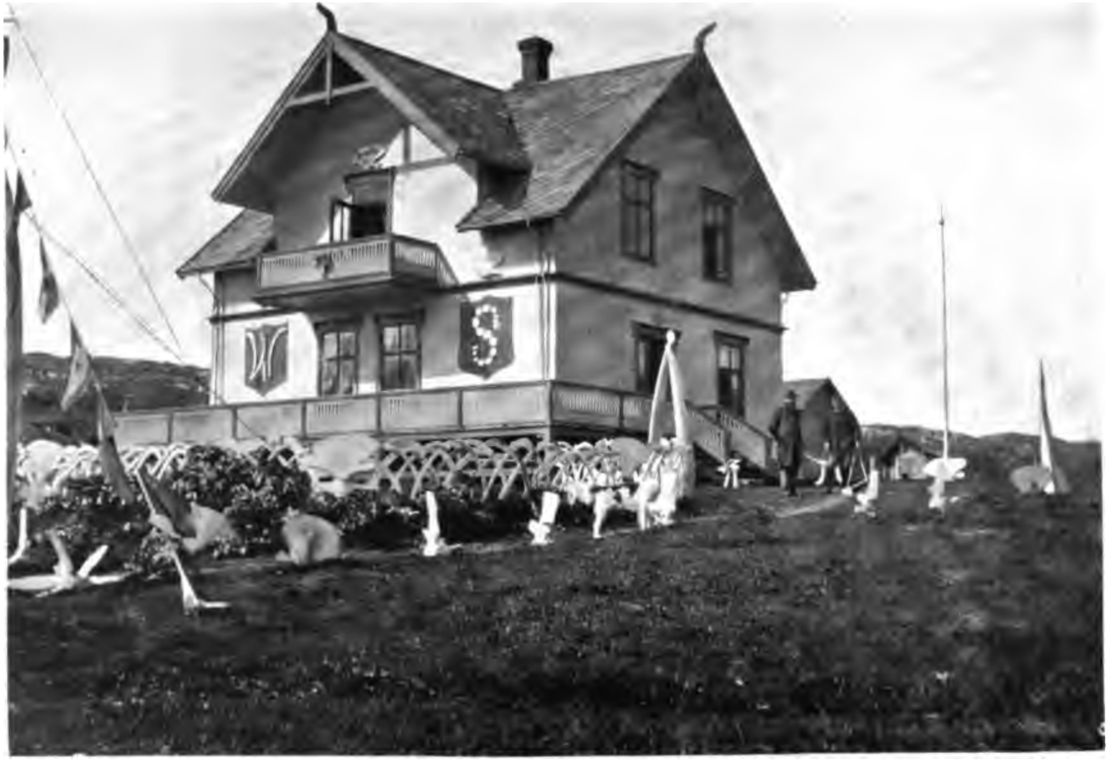
JUNE 1.—We met at Hull Station on the afternoon of June 1, and at once went on board the *Eldorado*, leaving our luggage in the care of "boots" of the Station Hotel, an able little man well known to all travelling by this route to Norway. After a fair passage we reached Bergen early on the 3rd, and found the *Laura* awaiting us in the harbour.

Owing to the kindness of our Consul-General at Christiania, we had little trouble with the Customs beyond the signing of various papers, and our luggage, stores, &c., were transhipped in a barge under the charge of two of their officers. We were thus enabled to leave Bergen on the evening of the 4th.

The next few days were chiefly occupied in reducing the chaos of stores, luggage, &c., to some slight degree of order. Herr Giæver had done all in his power to make the ship as comfortable as possible; but it is scarcely necessary to say a Norwegian sailing vessel is not an English yacht. Our day accommodation consisted of a cabin of 17 feet by 12 feet; of this space 6 feet by 12 feet were taken up by a small anteroom — most useful for bird-skinning, &c.— cupboards for our crockery, and a "captain's bunk" reserved for our collecting apparatus, leaving 11 feet by 12 feet for meals and general work. Strict order became at once the rule of the saloon, and life seemed largely occupied in putting things straight. Only one of us could spread out his work comfortably at a time, and all were obliged to clear the decks before a meal was possible.

The sleeping-cabin was amidships, and measured 15 feet by

PLATE 16.



F. 11. 1/25 *S.* 12.30 *p.m.* 15-6-97.

HERR GIÆVER'S HOUSE, SKAARÖ.

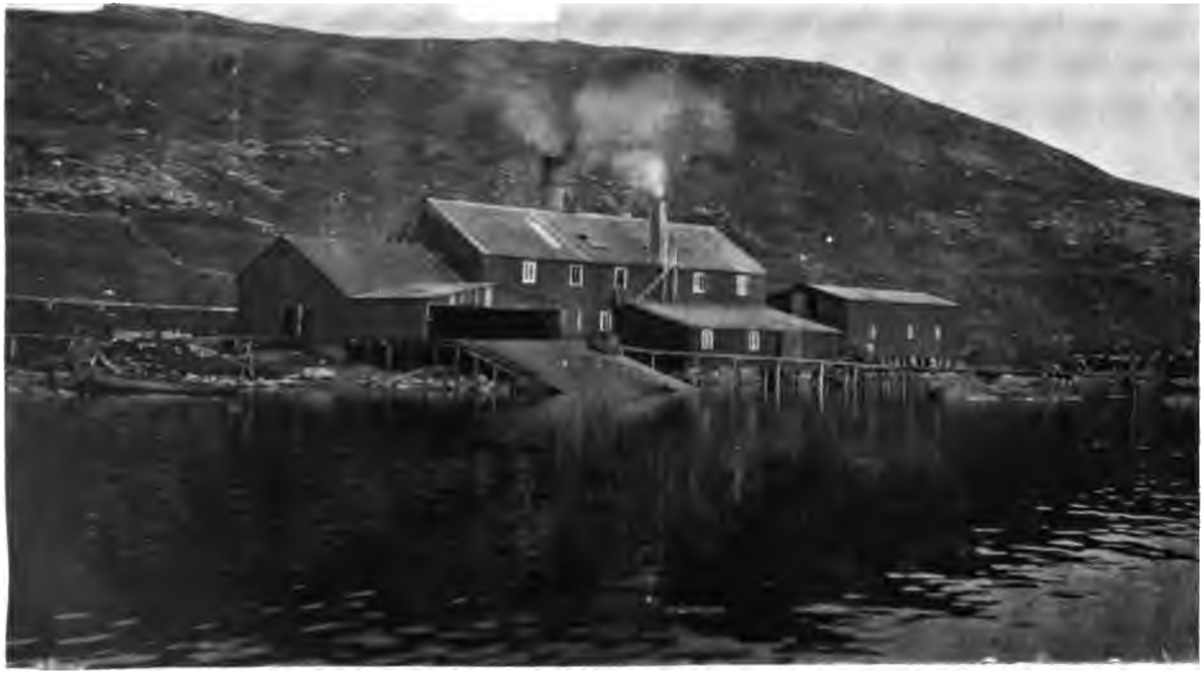
9 feet 9 inches. On one side were four bunks, two above and two below, provided with most comfortable mattresses, but sadly deficient in room. We slid in like paper-knives into a book, and when there, each man's nose nearly touched the bottom of the bunk above. Both day and night cabins were on deck. Under the former a small space had been partitioned off for the cabin stores, making also a dark room for photographic purposes.

June 12.—We did not reach Tromsö till the 12th, the engines proving unable to force the ship against a strong head wind. After our arrival, there were many details to arrange with Herr Giæver, which occupied most of the afternoon. As soon as these were completed, we went into the woods near the town to revisit several old haunts. The bird-life did not appear to be nearly as abundant as in 1895. A Marsh-Tit had young in a rotten stump three feet high; this species is one of the earliest breeders among the small birds in the North, having eggs generally in May. It may be well to say here, that no decayed trees should be passed in the breeding season without giving them careful scrutiny, as there are several species anxious to obtain such sites, and the supply of suitable ones is very limited. The Pied Flycatcher often selects so thin a dead birch that only the bark is left to form the sides of the nest. Fieldfares had young, and were busy carrying food from the strand to them at midnight. Young Hooded Crows were fully fledged. We found only a Brambling's and a Mealy Redpoll's nest with eggs, so it must have been an early breeding season here. The ship was regained at 1 A.M. The sun high in the northern sky made the air pleasantly warm, in spite of the snow-clad hills around.

June 13.—Something had gone wrong with the engine on the way up the coast, and now necessitated another day's delay. The Norwegian is not a rapid workman, but he sticks to his work. These men never left the engine from Saturday afternoon to 11 P.M. on Sunday, and they did not ask for beer-money! What with them, and the wives, daughters, sisters, cousins, and aunts of the crew, who all wanted to see the ship, the vessel became like a fair; even the store cellar was scarcely private, and we fled to land till bedtime.

June 14.—The engine being completed and a new cooking range fixed, we left Tromsö early for Skaarö, arriving there in the afternoon. Skaarö is a small island between Vandö and Arnö, situated some forty miles north of Tromsö, in the outer belt of islands, and with a well-protected harbour. Herr Giæver, appreciating its many advantages for his purpose, selected it some years ago for a whaling-station. His house, where he resides during the summer months, is illustrated at Plate 16. The garden fence there shown is composed of whale ribs; and flat bones from between the vertebræ of this animal form the initials on the walls.

Two small steamers, the *Duncan Grey* and *Nancy Grey*, with speed of nine to ten knots, are employed during the summer months in chasing whales, five species of which are captured here. The harpoons have hollow heads filled with black powder and an igniter, forming a powerful little shell, which bursts inside the animal. Close behind the shell are attached three movable and barbed arms, which expand as the beast draws on the line, thus giving the harpoon a firm hold. This is called the invention of the late Herr Foign, but the principle is identical with that of Manby, who invented a very similar bomb. (See "Journal of a Voyage to Greenland in 1821," by George William Manby.) Manby's invention did not meet with much favour at that time, and he afterwards developed it into Manby's bomb apparatus for saving life from shipwrecks, the parent of the present rocket so well known on our coasts. As soon as the whale is dead, the carcase turns over belly upwards, and quickly becomes distended like a balloon by the decomposing gases. A dead whale was probably the only foundation for the reports of Andrée's balloon being seen floating in the Arctic Ocean. After the whale is brought into harbour, it is secured to a buoy opposite the boiling-house. A man then draws a flensing knife from the tip of nose to middle of tail down centre of the back and on both sides from mouth to tail. The



F. 11. 1/25 *S.* 12.30 *p.m.* 15-6-97.

THE WHALE-OIL FACTORY, SKAARÖ.

blubber (about two inches thick) is next turned over at the tail, a chain attached to it, and the latter fastened to a windlass turned by two men. Under the gentle persuasion of the windlass, the blubber peels off like the skin of an orange, the man with the flensing knife now and again separating it from the muscles. It is then run up the sloping wooden platform, chopped into convenient pieces, and put into the boiling tanks, while the carcase is towed round to the manure factory. The whalebone, though short in all the rorquals, to which species most of those captured belong, has sold for as much as £250 per ton, but now it realises much less. A hundred and twenty-seven whales were killed here last year. Several royal personages have visited Herr Giæver's establishment, and in 1892 the Emperor William took part in a chase on one of the whaling-steamers, being present at the harpooning and capture of the whale depicted in Plate 18. Herr Giæver shows with pride a very handsome silver cigarette case, set with brilliants and containing a portrait of the Kaiser painted on ivory, sent to him by the Emperor. This whaling station is visited by most of the Norwegian tourist steamers, and I have heard many English speak of the kindness and attention shown by the genial proprietor and his wife.

The large amount of animal matter always about attracts numbers of birds and fish. Great and Lesser Black-backed Gulls, Herring and Common Gulls, and Kittiwakes were present in hundreds. Ravens were very common—we counted seventy on one hillside—and the White-tailed Eagles often attempt to secure some of the whale-meat at night when the place is quiet. But judging from the odour—I could use a much stronger term—of a Great Black-back during skinning, eating so much of this putrid matter must have a bad effect.

The establishment is closed in September; the men return to their homes in the south of Norway, and Herr Giæver to Christiania. Only one man is left on the island, who lives some distance from the factory. During the winter months, therefore, the birds are little disturbed. The cooper told us he got up early one morning in March this year, very shortly after his return to the north, and counted thirty White-tailed Eagles sitting at one time on the roof of the factory. Alas! the cooper has a rifle, and had not only shot three this season, but spoiled the skins by want of careful preparation. I believe he was the only man there who shot birds, and that they knew him personally. Curtis and I were busy during the evening photographing the gulls as they fought and gorged themselves on the whale carcases. The birds took little notice of us or of the workmen who passed backwards and forwards. Suddenly they all left and went over to another island opposite, a mile distant. We looked about for the cause of their departure, and the only possible one we could detect was the cooper coming down the hillside *without* a gun. No gulls returned until some time after he had left.

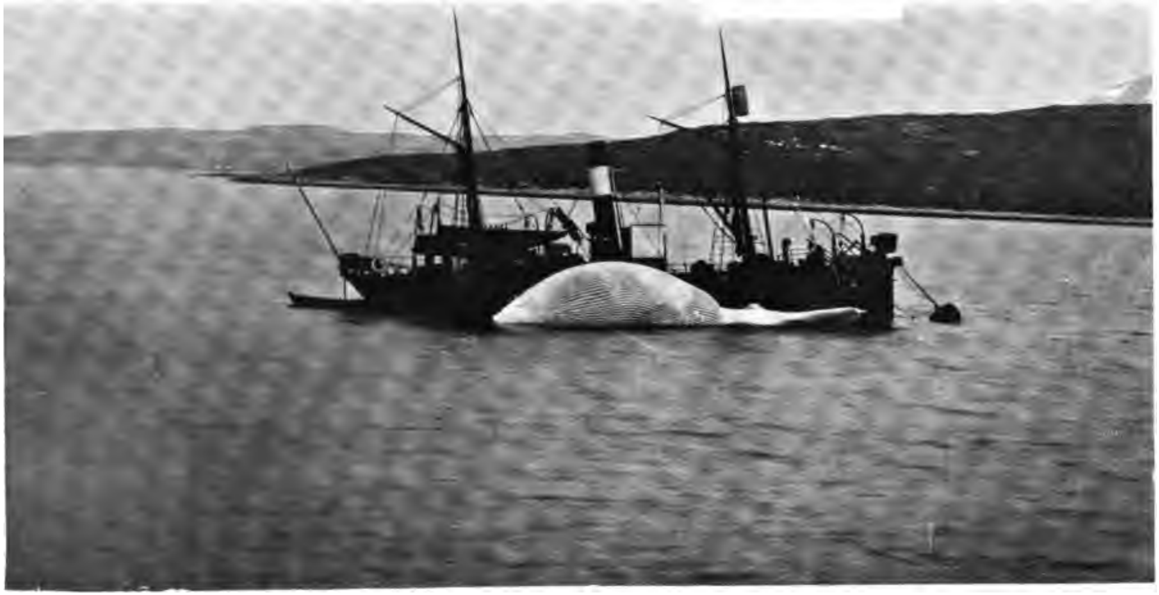
The climate of Skaarö must be very mild, for Marsh Marigolds were flowering beautifully in clumps 18 inches across, by a little stream near the house, and this in latitude 70° N. (Plate 20).

June 15.—We dined with Herr Giæver at three; a very pleasant dinner, followed by many speeches, for after-dinner oratory still lingers among the Norwegians in private life.

During the evening we visited a neighbouring island. The scenery was beautiful, snow-clad mountains rosy in the midnight sunlight, with several lakes surrounded by moorland at their feet; but the fishing in the latter was not good that day, and the nests were only represented by one Common Gull's and a Meadow-Pipit's.

The Norwegians are far too merciful to the Great Black-backed Gulls, and they have certainly increased since I first knew this coast. They are a perfect scourge to other birds. We watched them this evening swooping at the young Eider Ducks as their mothers tried to lead them to the water.

June 16.—Coaling! That word must recall a volume of suffering to those who have gone through it. Being a dry windy day, the fine dust penetrated everywhere, even to our bunks, and we could get no cooking done. Herr Giæver took pity on us, and carried us off to



THE "DUNCAN GREY" WHALER, WITH THE EMPEROR WILLIAM'S WHALE IN TOW, 1892.

FROM PHOTOGRAPH BY MRS. GLÆVER.

supper at his house; but we had scarcely finished when his nephew arrived from Tromsö with the news that the Consul's eldest brother had died suddenly that morning while writing letters in his office. This at once broke up our party; the Giævers returned to Tromsö in their nephew's steamer, and I spent the night till 2 A.M. in photographing the gulls. It was a weird sight, the clamorous birds tearing and dragging at the floating "krang" (carcases) of the whales that had been stripped of their blubber. The gulls alighted with loud cries on the gory mounds of flesh, fought, tugged, and gorged, often losing their footing on the slippery mass; yet not a trace of blood or stain could we see on their white plumage. I also obtained a good photograph of a fœtus taken from a Rorqual Whale captured yesterday. It was five feet long, its under parts a rich vermilion-crimson, shading into a fine purple-brown over the back, with black dorsal fin and tail. The skin was as soft to the touch as fine goldbeater's skin, and the fluting on the stomach was clearly indicated.

The men were busy all the night and following morning in washing our ship with the help of a hose-pipe from the shore, and she greatly needed it.

June 17.—It was 2 P.M. before we finally got away from Skaarö, the ship very deep in the water, her hold filled to the hatchway with coal, and every corner crammed with stores and gear for the crew and ourselves.

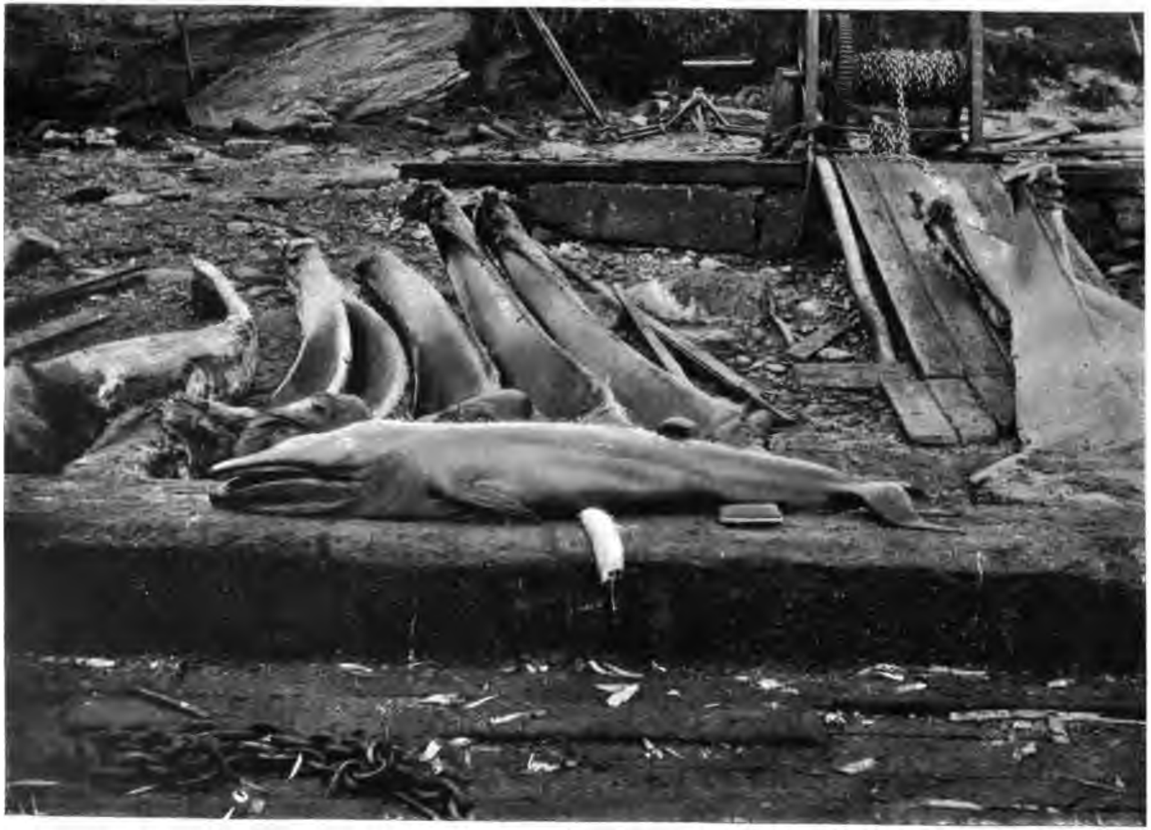
We had lovely weather during the afternoon; but this happy state of things was not to last, for we met half a gale blowing directly down Sörsund, and found it impossible to steam against it, so were obliged to go outside the islands. There our position was not improved, for almost a winter gale was coming from the ENE., which gave us twenty-four hours' discomfort; and during Friday the 18th the deck was covered with water most of the day, seas going over the cabins. That evening we were in lat. 71° 55′ N., and decided to run back for the channel inside the North Cape, an operation attended with some trouble, as the launch drifted up and twisted her tow-rope into the screw. With this exception, she behaved very well during the storm, and appeared to have taken no water in through her canvas cover.

June 19.—The next day found us once more in quieter water, and able to obtain a meal with some degree of comfort. We dropped anchor at Honningsvaag, as the wind was still too strong and easterly outside to make way against it.

This place is a considerable fishing-station near the south-east corner of the island of Magerö, whose northern extremity forms the celebrated "North Cape." It has a good harbour, well secured from winds, with fifteen fathoms of water, and is connected with the mainland by a telegraphic cable. We walked up the hills behind the village, but saw little of interest; the vegetation was very sparse after Skaarö, and bird-life was only represented by a Meadow-Pipit, female Snow-Bunting, and one bird unidentified—probably a Ptarmigan.

June 20.—We went ashore on the side of the fjord opposite the town, and climbed up Honningsvaag Fjeld. As the atmosphere was clear, we had splendid views of the Porsanger Fjord and the varied coast-line. Several ships and steamers were passing below us, one of the latter towing the wreck of a three-masted vessel. About 800 feet up we came upon a pair of Ptarmigan, *Lagopus mutus.* Both birds stopped for some time on a grey lichen-covered rock, craning their necks and calling. They formed the centre of a very pretty picture—a steep ravine with a stream leaping and sparkling between the rocks, the large bell-heather and other alpine plants making the background.

After crossing some large snow patches which afforded much easier climbing, we reached, at 900 feet, a bleak and bare tract covered with fragments of a grey granite, supporting little plant life. I photographed *Silene acaulis*, *Saxifraga oppositifolia*, and *Ranunculus glacialis*, the last growing in profusion, but always in isolated plants. We saw several pairs of Snow-Buntings and a Dotterel at this level. Struggling up over the rough splintered masses of granite, we had nearly reached



F. 32. 15 *S.* 9.10 *p.m.* 16-6-97.

FŒTUS OF RORQUAL WHALE.

the cairn at the summit (1100 feet above sea-level), when a female Ptarmigan ran from under Curtis' feet, and there in a deep depression lay nine beautifully marked eggs. The lining of the nest, which was tolerably deep, was composed of short stems of dry grass with some twenty of her own feathers. A photograph of the eggs and nest is given at Plate 21, from which it will be seen the eggs varied considerably in tone. Curtis shot the bird, and after removing her skin she was handed over to the cook, who found a tenth egg in the ovary, perfect except the colouring matter. The men on board had noticed us against the skyline, and the boat was waiting at the beach. The crew certainly maintain a much sharper watch than those of 1895 did. Our last letters and telegrams were despatched, the anchor raised, and Kjeldsen had orders to steer straight for Harbarova. At last we were off, but late, very late! These long delays up the Norwegian coast have caused us to make our final start at least ten days later than was intended.

Outside we found the gale had subsided and the sea was nearly calm. At midnight we were off the great bird-rock Svaerholtklubben, which forms the north-east point of the entrance to the Porsanger Fjord. It is a fine mass, some 900 feet high, with bold cliffs facing the sea; and was evidently originally detached from the main before the land rose to its present level, as a very distinct terraced beach can be traced connecting them. The whole of the rock to the north on the seaside was covered from top to bottom with the nests of sea-birds, every little ledge being occupied to its fullest capacity. The inhabitants consisted almost entirely of Kittiwakes, among which were scattered a few Guillemots and Shags. We steered close under the cliffs, slowed down, and sounded the steam-whistle. Thousands and thousands of birds rose into the air like swarms of bees, yet even a greater number remained on their nests. It was a grand sight, this great nursery of Kittiwakes, and we saw it under most favourable circumstances, for the midnight sun was shining in full splendour, an oil-like sea, the murmur of the rollers as they rushed up and recoiled from the base of the rock, the stupendous cliff, the countless fowls, the nest-crowded ledges, and, louder than the din of the steam-whistle, the cry of the feathered host rose in one prolonged wail.

A good account of this place is given in "Bird-Life in Arctic Norway," by Professor Collett.

June 21.—Midsummer Day. The wind had risen, and was right ahead as usual, so that we only made some two knots per hour for the greater part of the day. In the afternoon, when the tide met the wind, the sea rose enough to keep the decks well awash, and to somewhat interfere with our packing of stores and preparing kit for going into camp. Still the sun shone brightly till nearly midnight, when he retired behind a bank for a short time. We could then see the cape near Vardö as a faint blue line on the horizon.

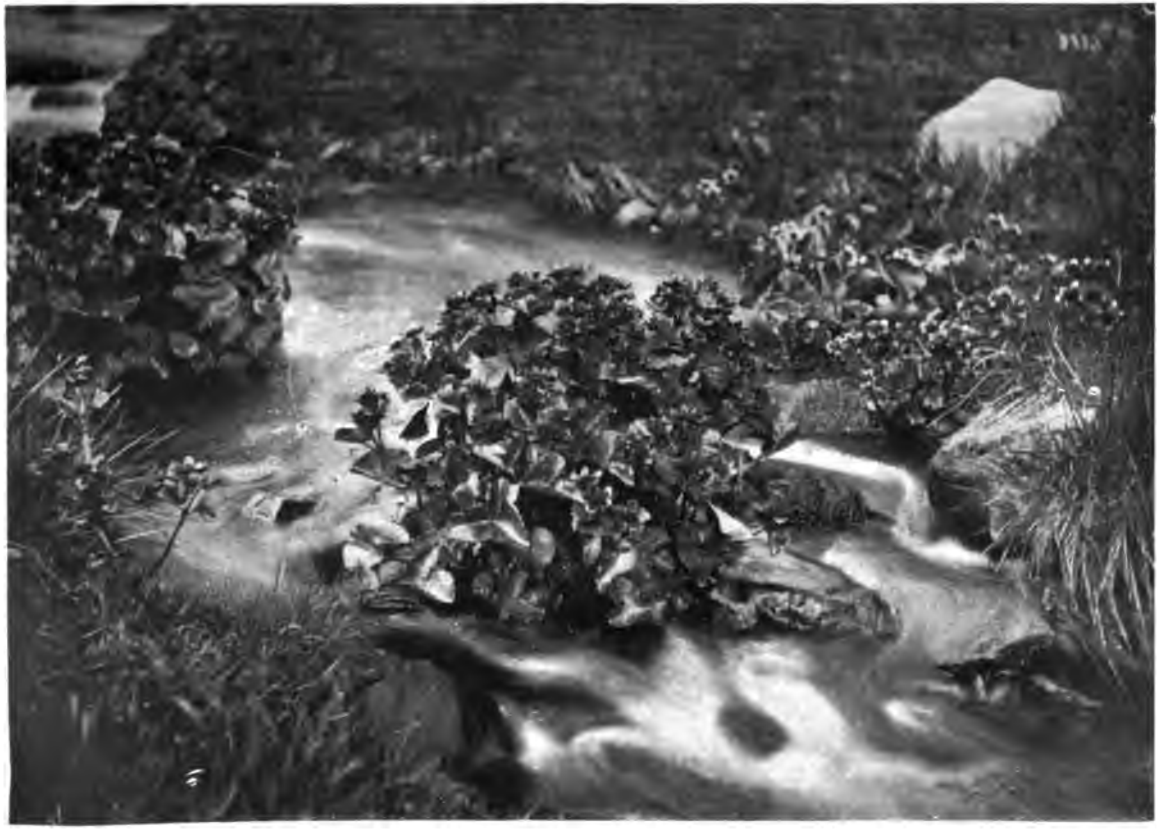
June 22.—The Queen's Diamond Jubilee. Position at midday, 70° 23′ N., 32° 57′ E. Temperature in sun, 80°; in shade, sheltered by the poop, 60°. We woke at nine to find real "Queen's" weather, a bright sun, quiet sea, and gentle breeze from the SSW., the first favourable wind for many days. The Lapland coast stretched away on our starboard side at some sixteen miles distance.

Kjeldsen had dressed the ship with every bit of bunting on board, the flag of Norway at the peak, the Union Jack at the main, the Royal Mersey Yacht Club burgee and a great flag with "Laura" at the fore, and signal flags everywhere.

Just as we were about to fire a salute at twelve o'clock Greenwich time, the whole crew came aft, headed by Captain Kjeldsen, who said, "Mr. Pearson, I cannot say what I do want to, but we all do wish to drink the health of your good Queen." This they did, with a three times three that few Englishmen could have excelled.

June 23.—Position at noon by observation, 70° 10′ N., 38° 25′ E. Shade temperature in wind, 47°; in cabin with doors and window open, 60°. Another lovely day, but light and variable wind from the south-west, which gave us very little assistance. We only made 114 miles in the twenty-four hours. Many Kittiwakes and some

PLATE 20.



F. 11. 1 *S.* 1 *p.m.* 15-6-97.

MARSH MARIGOLDS AT SKAARÖ, 70° N. LAT

Pomatorhine Skuas (the latter adult birds with twisted tail-feathers) have been constantly about the ship during the last two days. The Kittiwakes took a great fancy to the red stocking at the mast-head, and spent most of the day in trying to tear it to pieces. Their efforts to settle on it were amusing; at times one would catch the end in his beak, throw his feet forward against the wind, his wings out to get all the leverage possible, and then tug with all his might. But Mrs. Kjeldsen's handiwork was strong enough to defy all their attacks.

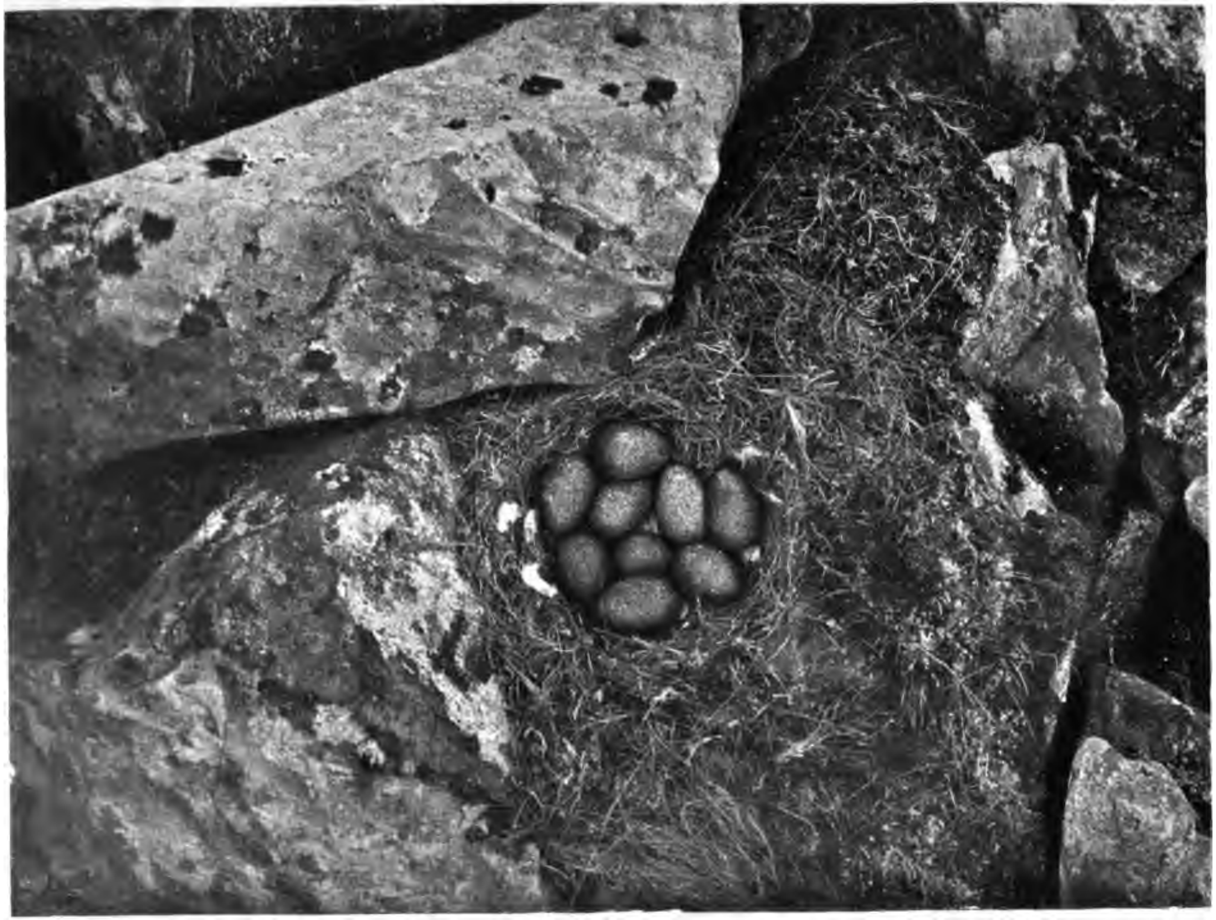
June 24.—Position at noon, 69° 28′ 5″ N., 43° 25′ E. Shade temperature in wind, 50°. Light east wind; course, one point E. of SE. A very beautiful day, if our only object here were to enjoy the bright sunshine, the bracing air, and everlasting day; but while we are crawling along, eggs are hatching and flowers blooming on the still distant shore. Since we left the coast of Norway, Barents Sea has been more like a great inland lake under some southern sky than its usual self. There is nothing like grumbling at fine weather to produce a change, and in the evening rain came on, accompanied by a shift of wind to the north, which increased our speed to six knots. A few Brünnich's Guillemots were seen about the ship during the day. We noticed that the Kittiwakes and Skuas decreased in numbers. In the evening five "Grey" Geese, one larger than the other four, passed towards the east. A King-Eider was also seen by Kjeldsen.

June 25.—Kolguev was sighted early. When we turned out at six, we found we were off the south-west end of the island, with the sandbar, which forms the shore-lake, three miles away. Two sandbanks stood up above the water more to the south. The temperature in shade in the afternoon was 41°; that of the sea-water at surface 40°, both then and at 11 P.M. No ice was to be seen on the sea in any direction. As soon as our position was ascertained, we turned and steamed up the west side of the island, keeping some four miles from shore in ten-fathom water. The wind from the north increased, and was now dead ahead again for twenty-four hours, producing a lumpy sea that made meals anything but pleasant. Rain also fell most of the day, and, seen through it, Kolguev looked as ugly and forbidding a shore as one could well imagine; there was certainly less snow remaining on the land than when we visited it in July 1895. At 5 P.M. we were abreast of the mouth of the Gubina River, and at eight we passed the north-east corner of the island. During the day we saw three Glaucous Gulls and some twenty-five Skuas, chiefly Pomatorhine.

June 26.—Position at noon, 69° 41′ N., 57° 13′ E. Temp. in shade, 46°.

The lively antics of the *Laura* continued until 5 A.M., when the sea went down and a thick fog came on, which only lifted for a few hours in the middle of the day. At about 8 P.M. it dispersed, and soon after midnight we saw a slight rainbow, caused by some shower in the distance. It had only one arm, and had a different name, as in English, to that given the full bow—so Kjeldsen told us. The night was so beautiful, it was nearly 3 A.M. before we turned in.

June 27.—Position at noon, 69° 48′ N., 56° 41′ E. Temp. in shade, 52°, and of sea-water, 50°. The surface water was brackish and of a peaty colour. Kjeldsen reported we had passed more trees and driftwood during the night than he had ever seen here before. Evidently the great Petchora River had awakened into life again, and was pouring her vast deluge into the icy sea laden with trunks of trees, branches and roots, the tribute of the forests, which were floating broadcast. From the high temperature of air and sea we hoped that the ice was still far off, or had all been carried out to the northward, leaving our passage clear to Habarova and Khapidirsk Bay; but alas! shortly after noon an ominous ice-blink could be seen, and from the rigging the outskirts of the pack were in view. We were soon among the ice, and worked through it for some miles into open water beyond, but were brought up by an impenetrable barrier of pack-ice extending from ENE. to SSW. The



F, 64. 1 *M*. 6.30 *p.m.*

PTARMIGAN'S NEST, *Lagopus mutus*.

(1100 FEET) HONNINGSVAAG, NORWAY.

20-6-97.

ship was then (2 P.M.) on the meridian of 57° in twelve fathoms. Turning to the south, we skirted through the edge of the pack till 4 P.M. when we made fast to a large floe, and filled our water-tanks from a pool of fresh water on it. A cast of the lead here gave ten fathoms.

While the men were getting water a seal came up close to the ice. Kjeldsen, with the agility of a lad of twenty, rushed down and shot him through the head, but unfortunately the man with the hook was not quite as quick, and just missed securing the animal. It sank like a stone. In the evening Curtis saw a flock of King-Eiders on the sea to starboard, and we quietly followed them with the ship until within long range, when he gave them the contents of both barrels of his eight-bore, and five drakes were secured, four of them in splendid plumage, the fifth moulting. On opening one of these birds, we found in its gullet a whole *Mya* an inch long, and a large *Mactra*. As there was no sounding of less than ten fathoms for miles around, it follows that this species can procure its food with ease at a depth of 60 feet or more.

During the day we saw a Sanderling, one or two Redpolls, two Divers, an immature Glaucous Gull, Black Scoters, Long-tailed Ducks, and (I think) an immature *Larus affinis*. One of the Redpolls alighted on deck and pecked about for food.

Kjeldsen worked down the edge of the ice at half speed towards the west through both the night watches, only to find it still closely packed to the south and south-west, and extending approximately to the ten-fathom line, which is here some twenty miles distant from the Russian coast. He called me in the early morning to report we were to the west of the mouth of the Petchora River, and that the ice extended to the south-west as far as he could see from the masthead. We had passed several deep bays in the ice running far to the south, but dare not try them. The sea is very shallow, and there is no harbour, or even tolerable anchorage, along the whole of this part of the Russian coast, so that had we attempted to force our way to land down one of these bays, and the wind had risen from the north, the ship must have been lost. We were obliged, therefore, to put about and try to the east, as it was now quite clear we could do nothing towards the west in the present state of the ice.

June 28.—Position at noon, 69° 40′ N., 57° 21′ E., a little east of that yesterday at the same hour. Up till noon we had a pleasant bright sun, lighting up the ice and making it look as pretty as such bay ice, composed largely of frozen snow, can look. Feilden says it was the dirtiest ice he had ever seen; it was all of one season's growth, much broken up; most of it was coated with mud, and occasionally so thickly as to appear doubtful in the distance whether the lumps were soil or ice. In this shallow sea a storm soon churns up the mud, and each wave deposits its quota as it dashes over the ice. The many square miles of ice in sight were carrying thousands of tons of soil out to Barents Sea. This process, continued through several centuries, must have considerable effects. Soon after breakfast we passed a large mass of ice stranded in ten fathoms; it was fast on the bottom, judging from the current running past its sides. None of this bay-ice is originally more than about eight feet thick, but tremendous storms raging over these seas from the north in the spring, force great floes on each other till they are piled up to a height of 50 or 60 feet, five-sixths of the mass being in the sea.

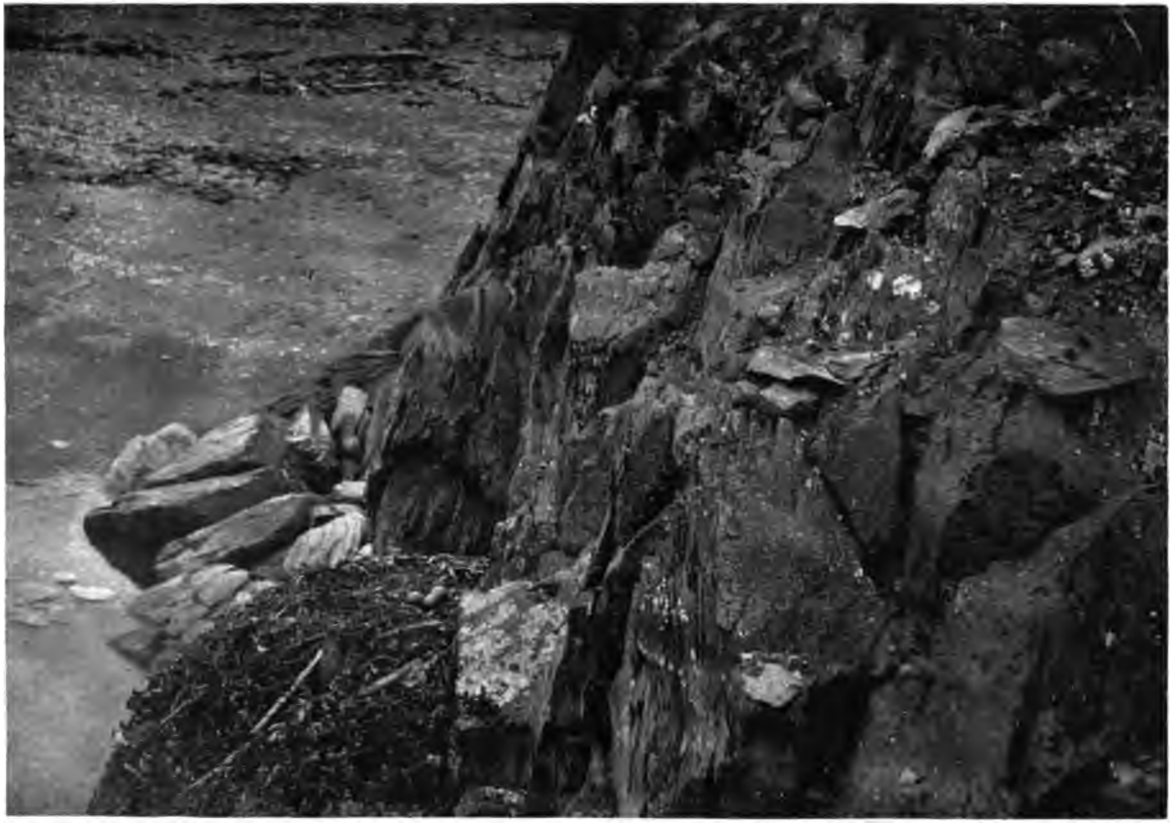
We continued to work through the ice-floes along the edge of the pack towards the east till 2 P.M., when it became plain we must change our course, for the only open water to be seen from the mast-head was between north and north-west. The edge of this large area of ice is a continual series of great promontories with bays or fjords between them, reminding one rather of the coast of Norway. Often the ends of these bays could not be seen from aloft, and gave rise to the vain hope we had at last found a passage through, but after some hours' steaming we always discovered ourselves to be in a *cul-de-sac* and had to retrace our way.

The wind had now changed to the north, and the sky became covered with clouds, the latter soon giving place to a thick white fog. Kjeldsen says a north wind generally brings fog in these seas during the summer. As the wind increased it put the ice in motion, and the masses grinding against each other produced a gruesome sound not easily forgotten. All this time we were making the best way we could in a northerly direction through the long streams of ice projecting from the main body. Late in the evening the fog cleared, and we appeared to have rounded the north-west corner of the pack; so Kjeldsen went to bed, leaving us on a north-east course which ought soon to bring us near Harbarova; but alas! for human hopes, in half-an-hour the fog was worse than ever, and the ice closing in from the south-east forced us into a N. and then NNW. course for some time. In the spring and early summer these great fields of ice are ever changing their shape and position under the influence of wind, tides, and currents. During the early part of the night there appeared to be a strong current with us, carrying numbers of small pieces of ice out from the main body in a NNW. direction against the wind.

Enveloped in fog, moisture dripping from the ropes in every direction, the everlasting growl of the ice, the strain of keeping a sharp look-out ahead to avoid contact with the detached masses, and a knowledge this north wind might bring down other ice and trap us, made that night one to be remembered.

About 4 A.M. we sighted a small island ahead, and shortly after a larger one. Fortunately the fog now cleared considerably. Kjeldsen, who had been called as soon as land was seen, went to the mast-head, and reported a number of other islands. We had altered our course so constantly and in all directions during the last twenty hours, that we were a little doubtful as to our present position, but at last came to the conclusion these must be the islands off Dolgaja Bay, at the north-west corner of Waïgatch Island, and the sea ahead the Kara Gate. After some consultation, we decided that the best course was to force our way through the ice intervening between us and Dolgaja Bay, and seek shelter there until the coasts were once more surrounded by open water. It was quite clear, from our experience during the last thirty-six hours, that the ice completely blocked the whole coast from the west of the Petchora to the north of Waïgatch, making it impossible to reach land at present in any part of the district we desired to visit; and our decision was somewhat quickened by the fact of the ice rapidly closing up behind.

PLATE 22.



F. 32. 8 *S.* 9.0 *a.m.* 29-6-97.

PEREGRINE FALCON'S NEST. *Falco Peregrinus.*

DOLGAJA BAY, WAÏGATCH.

CHAPTER VI

DOLGAJA BAY, WAÏGATCH

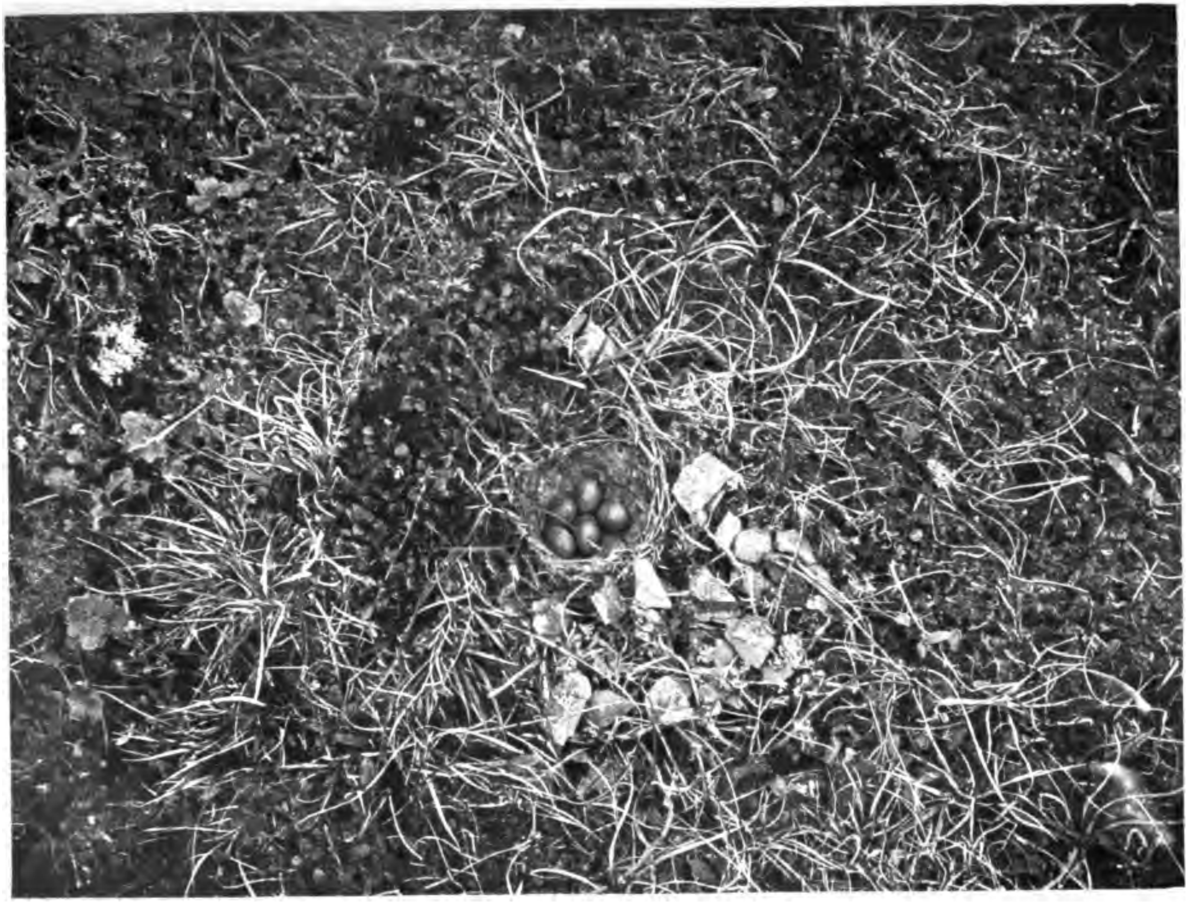
JUNE 28.—Between us and our desired haven was a broad belt of stream-ice coming out of the Kara Gate, and then about two miles of close pack. Kjeldsen pointed out to us the risk of the ship becoming fast, and drifting out to sea in the ice; or, if she got safely through, we might be kept there all the summer. However, "nothing venture, nothing have," and we were all anxious to feel our feet on land again; so at it we went, and the next two hours were exciting enough. The *Laura* charged the ice well, but wanted more power in her engines and often stuck fast. All hands were called up, and worked with a will, pushing the floes apart with long poles, and racing to any point where extra assistance was required. Sometimes we were forced back, only to seek a softer place and try again. At last we broke through into open water and gave three hearty cheers.

The poor old launch had even a more trying time than the ship, and she got much less attention. I saw her once dragged over a floe with one side three feet under water; time after time she would have sunk but for the painted canvas cover. The lead gave twenty fathoms at the entrance of the bay, and brought up a dark green mud like that on Kolguev.

We turned in at six, but could not sleep, and were up again at eight. Kjeldsen had found a very snug anchorage between a small island on the east side of the bay and the main island, protected also by a shingle bar from the ice which might be driven down from the north-east. He reported that he had discovered a Falcon's nest on the island next us; in fact, the place could be seen from the deck, and this made us all the more anxious to land. After nine days on a small ship almost any land is pleasant, and we were rather inclined to look at things through rose-coloured spectacles. Still that island was very pretty, a perfect little Arctic garden; the south sides of the hillocks being a mass of colour. Leaving Feilden to fill his botanical case, I went direct to the cliff with Kjeldsen, who showed me three handsome Peregrine's eggs in a nest placed upon a projecting point of rock some fifty feet above the sea. The eggs were half incubated. The nest was formed of an immense accumulation of sticks, and had probably belonged originally to a pair of White-tailed Eagles, which had added to it year by year; but where did the sticks come from? I really believe there were more in the nest than we saw growing over the whole island of Waïgatch. In any case, that heap represented an enormous amount of labour. On revisiting this spot three days after, we found a large mass of the cliff had split off, carrying the nest and its surroundings into the sea below. Unfortunately the photo at Plate 22 does not show the whole foundation of the nest. The position was an awkward one, and enabled me to realise the difficulty Mr. Oswin Lee must often have had in taking the beautiful series of photos for his book "Among British Birds in their Nesting Haunts." Two Common Eiders also had eggs on the island.

After lunch we landed on Waïgatch, taking Kjeldsen, Hansen, and Daniel Johannesen with us. Hansen became my attendant on shore during most of our excursions. He was a fine active fellow of twenty-seven years, who was studying for his captain's certificate; knew a little English, was always bright, pleasant and willing; and was equal to the longest day I could do. His duty was to carry the camera, weighing with its case, &c., 17 lbs.—quite enough for a ten or twelve hours' walk over bogs and every other description of bad ground; and he soon learnt to set up the stand as well as I could. During nearly two months he never had an accident with his charge. Unfortunately he was badly provided with boots, for the

PLATE 23.



F. 64. 15 *S.* 4.30 *p.m.* 30-6-97.

SHORE-LARK'S NEST *Otocorys alpestris.*

DOLGAJA BAY, WAÏGATCH.

bootmaker in Tromsö had failed to finish his new ones before the ship left. After watching him wade through the ice-cold streams for a day or two, a brilliant idea occurred. I had a pair of fishing waders with macintosh tops reaching well up the thigh, and leather soles provided with nails which never come out; absolutely perfect for Arctic work *if they fit*, but not quite such a source of joy if one of them persists in rubbing a sore place on your heel! I took them to Hansen to try on, and they fitted him splendidly, so I gave them to him at once. The men said he went to bed in them that night, but I don't vouch for the truth of the statement. Thenceforward he had dry feet, while I walked comfortably in a pair of shooting boots, and when the water was too deep for them, Hansen carried me over.

Daniel became Feilden's henchman also from that hour. Quite a character was Daniel, and a very different style of man to Hansen, but a right good fellow. He had been out with the Swedish Expedition to Spitsbergen the year before. His duty was to carry Feilden's fishing-basket and collecting gear. Being only twenty-four, and not deeply interested in Arctic botany, his pace sometimes was rather too rapid for a proper study of that fascinating science; whereupon Feilden promptly changed his attention to geology, and soon discovered some interesting fragments of slate, with which he loaded the fishing-basket, and kept Master Daniel at a steadier pace. Harald and Johannes, who sometimes accompanied us, were typical Norskmen of the fisherman class, good useful fellows, but not to be compared in ability with the first two.

We found birds very plentiful here. Snow-Buntings were to be seen at every turn; but all appeared to have young, for their beaks held great bunches of another old friend, called "*Culex damnabilis*" by Edward Rae in his "Land of the North Wind."

We often watched the birds threading their way through the grass like mice, and gathering mosquitoes at every step, till, their beaks being full, they perched on some stone and took stock of us, evidently debating the safe moment to fly off with their spoil to the young. Fortunately to-day the wind was cold although the sun was bright; so the mosquitoes lay quiet in the grass and did not trouble us.

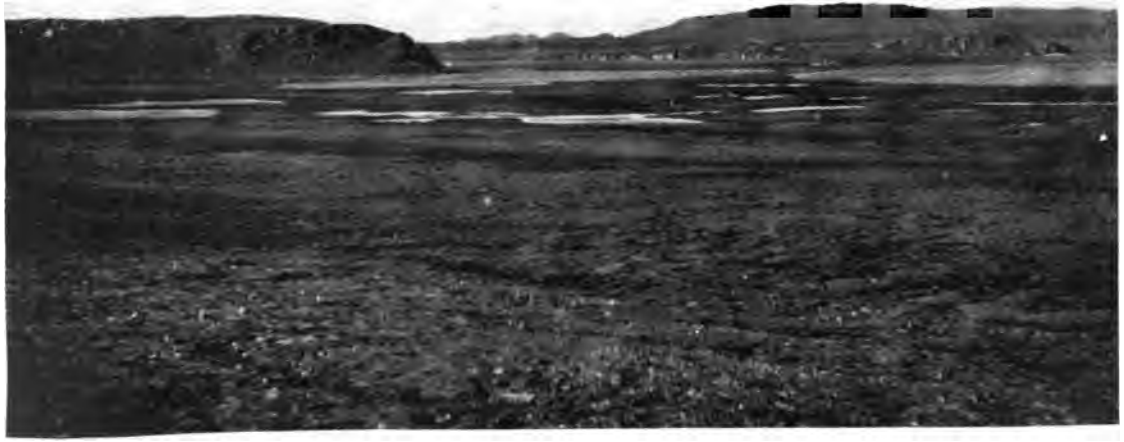
The first nest seen was a Dotterel's with three handsomely marked eggs; it was placed on some rough ground close to the edge of a marsh and 50 feet above sea-level. The bird on the nest proved to be a male.

Curtis and Kjeldsen being engaged in stalking two Snowy Owls, Feilden and I crossed over an undulating country, very damp and marshy in the hollows, and the ridges composed of slate. Wherever the rock was exposed, it showed clear traces of ice-action. We were much struck with the quantity of grass we saw, so very different from Kolguev, and more abundant than on Goose-Land in 1895. After walking some two miles we came to a long range of hills of 150 feet elevation above sea-level—the highest yet seen—with steep cliff-face on the side we were approaching. As soon as we entered the valley below, two Rough-legged Buzzards appeared in the air above the cliff, uttering their cat-like call. On climbing the hill, we found their nest placed on a ledge 20 feet from the top; it was composed entirely of grass, and contained three young birds in down, while beside them lay a young Snow-Bunting minus its head. This species had not been previously recorded from either Waïgatch or Novaya Zemlya.

We then went down into a large marshy valley containing several lakes, and rejoined Curtis. He and Kjeldsen had been successful in shooting two Snowy Owls, the male with scarcely a speck of colour on him; the feathers of the female had lost most of their barbules by mites, and presented a peculiar wiry appearance. The remains of a Snow-Bunting were in the stomach of the female.

This valley was a great resort for waders; in fact Little Stints were so numerous that we called the principal sheet of water "Stint Lake." We were pleased to renew our acquaintance with them, although their presence here upset a theory formed in 1895, namely, that their breeding-area is generally confined to the shores of tidal water. That

PLATE 24.



F. 11. 1.25 *S.* 4.30 *p.m.* 30-6-97.

"STINT LAKE" DOLGAJA BAY. WAÏGATCH.

was our experience on Kolguev; but on Waïgatch they were nesting in all the marshes we visited, some of them miles from the sea. Two nests were found near the lake, the second with eggs much incubated. Red-necked Phalaropes were also plentiful round the lakes, but not so tame as those I saw in the south of Iceland in 1894. There, I was firing at a Great Northern Diver on a lake in the South Fiskevötn district, from an islet round which a number of Phalarope were swimming, and several of the birds remained on the water at a distance of only ten to fifteen yards; they certainly seemed a little uneasy about the noise, but at once recommenced catching flies off the rushes.

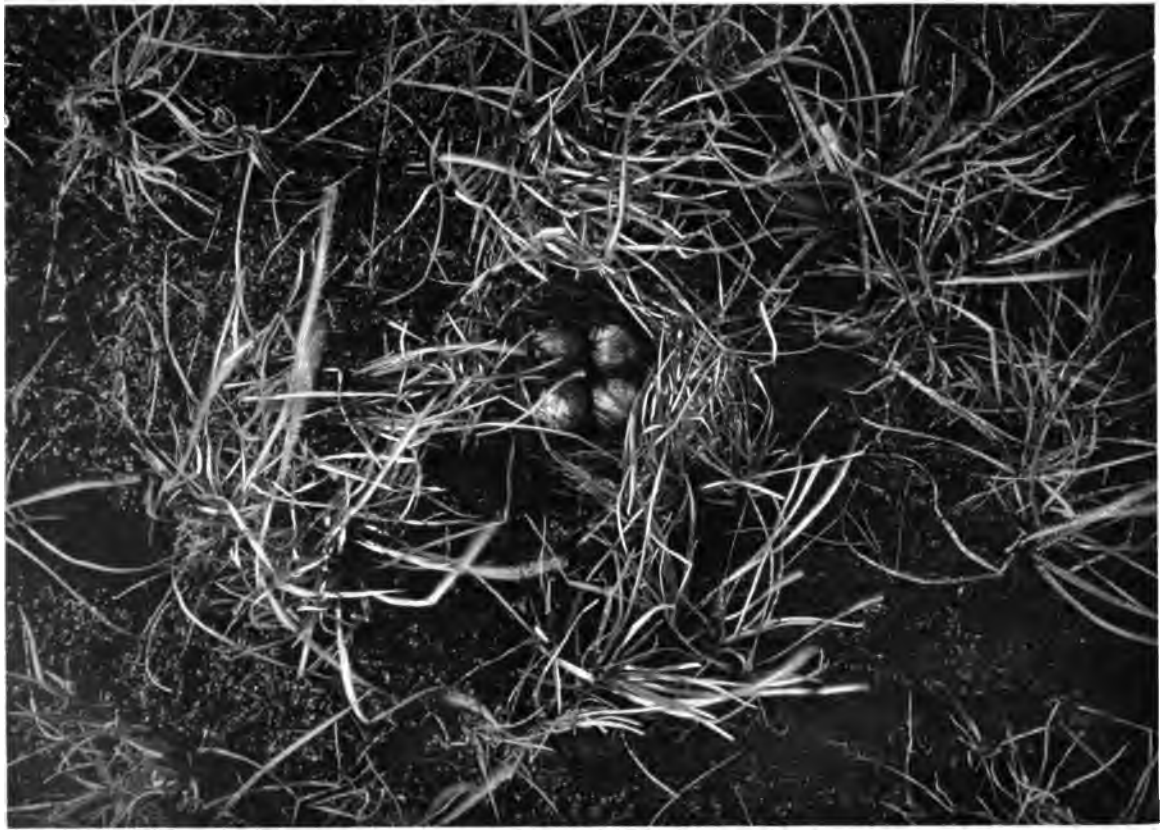
A few Ruffs and Reeves were seen to-day, giving us a second new species for the island. A pair of Black-throated Divers were on the large lake, and had a nest with two eggs close to its margin; unfortunately all the films were used, so I left the eggs to be photographed *in situ* next day.

June 30.—I took three men to Stint Lake to photograph the above nest. Whilst I was engaged on that, they found Little Stints' nests, a Snow-Bunting's, a Reeve's, and a Shore-Lark's. The Shore-Lark's was a very pretty nest. I carefully removed the piece of ground where it lay, and the men carried it down to the boat on a slab of slate. On examining the photo of this nest (taken *in situ*) at Plate 23, there will be noticed a number of pieces of light brown shale on one side; these were the only stones within a circle of many feet, and I have little doubt were brought by the bird to divert attention from the light-coloured eggs and nest, set in the midst of moss and other dark-coloured substances.

After lunch we took the launch up the east coast of Dolgaja Bay, visiting the various small islands, whose only interest lay in their geology. Several nests of the Common Eider were found on them, containing five to seven eggs. All these islands appeared to consist of slate, their tops ground down by ice, and afterwards covered by mud or slate-rock decomposed by the severe frost action. They reminded us of the islands off the south coast of Goose-Land. From the islands we steamed over to Boronov Nos. This is a hunting-station of the Samoyeds during the winter and early spring, as the tides and winds in the Kara Gate generally keep some small portions of the sea open; and these spaces attract the seals, who are followed by the Ice-Bears. Judging by the remains of twenty-five or thirty seals on the beach, the Samoyeds had only recently left the place. Many of the seal-skins were pegged out over the short grass to dry. A small boat of rickety construction was hauled up on the beach. All the drift-wood had been carefully collected into piles for future use, and near one of the old fires were several wings and broken egg-shells of geese. It is rather heart-breaking work to traverse the country after it has been devastated by these Samoyeds with their hordes of dogs, who sweep off everything edible. A Glaucous Gull was intent on obtaining a meal from the seal carcases, and this was the first of the species we identified on the island. From the headland we obtained a good view of the Kara Gate, and saw that the ice was closer than when we came into the bay, so that it would now be quite impossible to leave. Little Stints were very numerous round a pool behind the shingle bar; they are far the commonest birds on Waïgatch after the Snow-Buntings.

We then worked across the peninsula to the east side, sending the launch round the Nos to meet us. The country was flat and marshy, with a number of small tarns; on the edge of one of these we found a Red-necked Phalarope's nest, and the male was sitting on the four eggs. A Little Stint's nest, placed amongst grass in some very damp ground, was secured; it contained four eggs; and as I sat near the nest blowing them, the bird came within a foot of me. We also saw a Dunlin with three young in down. The ice, evidently from the Kara, was much thicker than that in Barents Sea, and the launch had some difficulty in finding a way through it in the shore-water. As we steamed back we passed five Common Scoters within eighty yards. We got on board at 3 A.M. hungry and cold.

July 1.—The new month began badly, with twenty-four hours of continuous rain and fog, accompanied by a stiff north-east wind, and



F. 64. 10 *S.* 5.0 *p.m.* 5-7-97.

RED-NECKED PHALAROPE'S NEST, *Phalaropus hyperboreus.*

DOLGAJA BAY, WAÏGATCH

there was apparently a storm blowing outside the bay. Fog in the Arctic knows none of the laws which govern its actions in our temperate climate, for in England either wind or rain quickly dispel it. The temperature on deck was 37°. It was good to be in this well-sheltered anchorage, and enjoying the comfort of a warm cabin, instead of drifting about in the pack-ice outside.

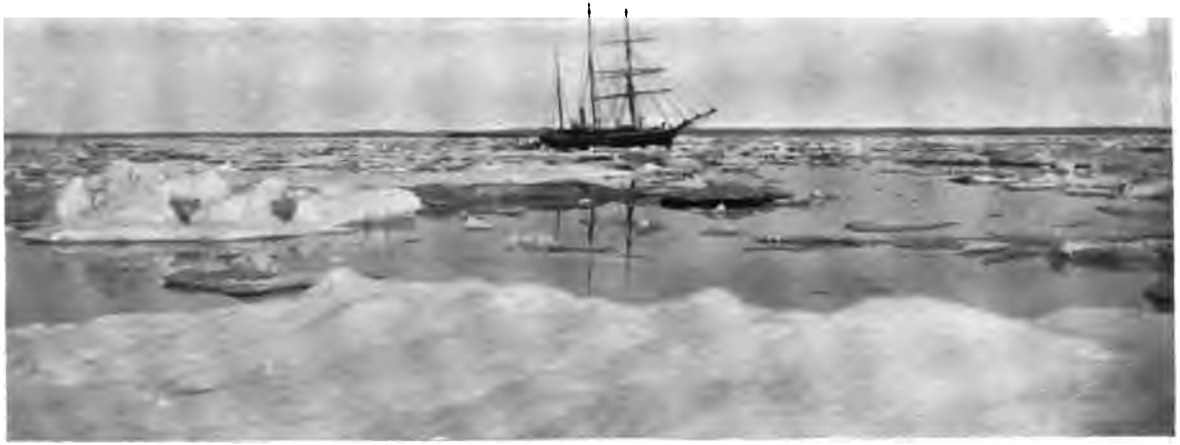
July 2.—On turning out, we were glad to see the rain had ceased and the wind gone down, although fog still hung about. Much of the ice had also gone out of the bay. We started at 1.30 in the launch to explore the head of Dolgaja Bay, steering first for an island situated between two headlands which mark the centre of the bay This island is not shown on most of our charts, but is correctly placed in the map of Waïgatch given by Mr. Jackson in his book "The Great Frozen Land," and we therefore named it, after him, "Jackson Island." We landed on a spit of shingle running towards the head of the bay, thrown up by the waves and ice sweeping round the two sides of the island. A fine Glaucous Gull flew down with angry cries to warn us off. The island is nearly circular, composed of slate with vertical cleavage, and surrounded by vertical cliffs on all sides. The only accessible point is that above the shingle bar; from thence we reached the top, after a stiff climb over loose rock and mud, only to find a large nearly level surface covered with more mud—it could not be called soil—and decomposed slate, in which a few plants struggled for existence. At one end of the island was the nest of the Glaucous Gull, containing three young in down; the whole family now repose in a glass case in the Bird Gallery at the Natural History Museum. Three nests of the Common Eider were on the shingle bar under the cliffs.

As the water in the launch's tank was getting low, we crossed to the west coast of the bay for a fresh supply, and while the men were obtaining it walked inland some two miles. In early spring the rains and melting snow convert all the rivulets into large torrents on Waïgatch, which carve out for themselves wide beds through the tundra, and carry immense quantities of soil to the sea. As the elevation of the hills is so slight, the whole snow practically melts at the same time, after which streams quickly resume their normal size, most of them scarcely rising to the dignity of a brook. We were walking up one of these broad dry beds of shingle and mud, when Feilden detected a deserted Snow-Bunting's nest, containing five eggs, and placed on a large flat stone near what had been the centre of the stream in spring; on the same stone were the remains of an older nest. Ten yards higher up we found two more old nests touching each other, and evidently made in successive years. All four nests were unprotected by any kind of cover or shelter. I believe this is a very unusual position for the Snow-Bunting to select, and find no record of any similar case. There seemed to be no local reason for such a departure from the ordinary habit of the bird, as within fifty yards were great screes, which afforded well-secreted nesting-places. Five Golden Plovers were seen a little higher up the tundra; and here also we first found Lapland-Buntings on the island, about fifteen or twenty. We only met with these birds in two or three places, a fact probably dependent upon the supply of some favourite food. One of the birds, a male, had its stomach crammed with insects. A Reeve which we shot had large incubating spots; its stomach was full of insects, chiefly diptera. We saw Purple-Sandpipers and Shore-Larks; a nest of the latter contained five incubated eggs, and was placed on a bluff near the beach. On the shingle below was the nest of a Ringed Plover with four eggs. Several Red-breasted Mergansers were over the sea.

Rejoining the launch, we steamed up the bay under the lee of the land to avoid the waves. The sketch on the following page will convey a better idea of the head of the bay than any long description, and is the more necessary as being typical of most of the bays we visited on Waïgatch.

A is a heavy shingle bar composed of sea-worn stones, stretching from shore to shore, and situated quite half a mile from D, the true head of the bay. It has a fine series of raised beaches, three being very distinct, the highest fifteen feet above present sea-level. The

PLATE 26.

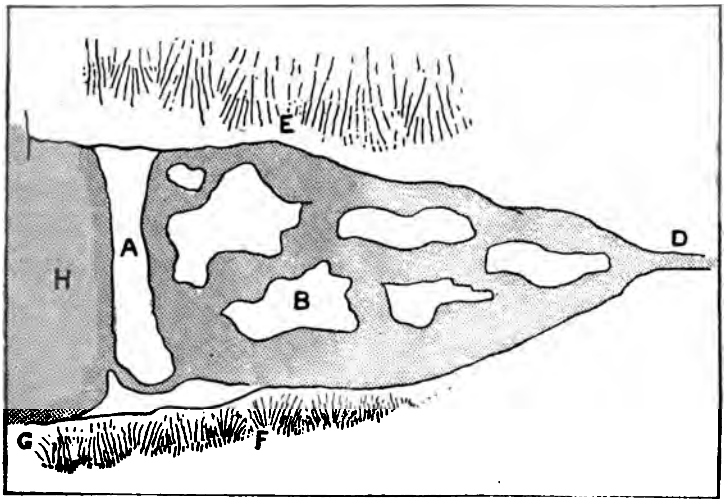


F. 11. 1 *S.* 9 *p.m.* 5-7·97.

S.S. "LAURA" IN DOLGAJA BAY.

PHOTOGRAPHED FROM ICE FLOE.

beach is strewn with a large amount of driftwood, some of the trunks sawn and axe-marked, amongst which Feilden picked up a good boat-hook apparently of English manufacture. We saw part of the skeleton of a small Cetacean, and other bones. This bar is pierced near the west bank, F, by a narrow channel forming the egress of the stream which drains the upper valley. At low tide B is a large area of mud and shallow pools, but is covered at high tide, which, rising little more than two feet, extends some distance beyond D. E represents a hillside covered with moss and sparse grass, gradually sloping up towards some hills beyond. The other side, F, rises much more steeply, and had a large snow foot at its base, extending for some distance on either side of G. The water was so shallow at H that the launch (drawing three feet) ran aground one hundred yards from the bar, and we landed below G. The weather being too bad to tempt us to stay longer, we returned under the lee shore, and crossed the wide part of the bay to avoid the waves; but with all our care we were wet through when we reached the ship.

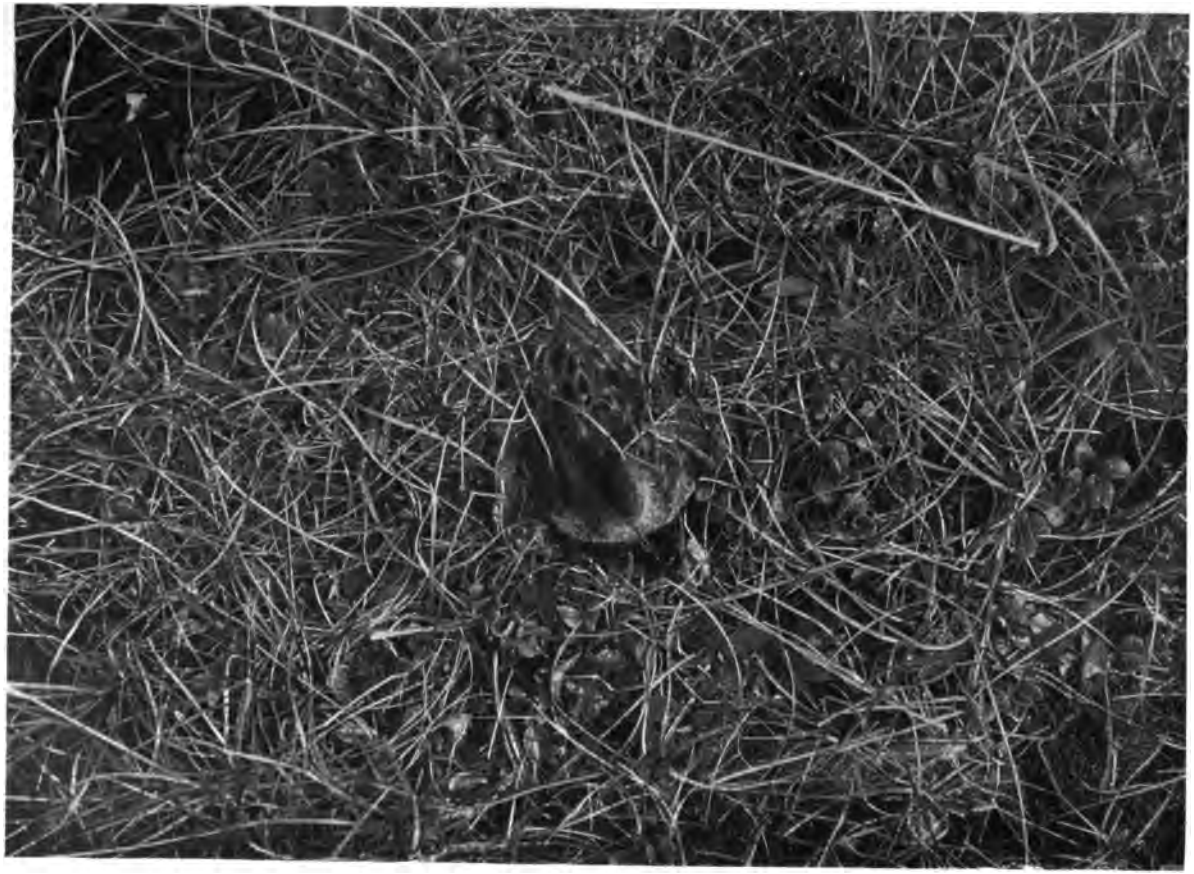


HEAD OF DOLGAJA BAY, WAÏGATCH.

July 3.—The next morning was finer, with very little wind. Wishing to complete the exploration of the country round the bay, we had a slight early lunch and started in the launch at 12.30. There was much more ice at the head of the bay than yesterday, and on it were several seals, *Phoca fœtida.* Of course Kjeldsen tried to shoot one, but they were too far off.

To-day we brought the small boat, and so were able to land on the shingle bar at A; the stream C prevented our reaching this the previous day. The mud flats at B made a fine feeding-ground for the Waders; Ringed Plovers and Little Stints were busy all over the place. Two of the former had young on the bar, and most troublesome they were to locate. It was only after lying down for forty minutes I was able to secure two in down. Comparing these afterwards with young in down of the same age taken in England, I found a remarkable difference in colour. The Waïgatch birds are a mixture of dark grey—almost black—and brown over the head and back; whereas the English Plovers are of a much more sandy colour. This is a good instance of Nature's adaptation of colour for protective purposes. All the beaches of Waïgatch are composed of water-worn fragments of slate, and these little fellows so exactly match its colour you may stand within a foot without perceiving them; the English youngster would be detected at once on the slate.

Two nests of Little Stint were among the fine grass on the shore side of the bar, and several others were found on the higher ground at E, in rich-coloured brown and green moss, through which a little grass grew. Some of the latter contained beautiful clutches of richly marked eggs. While taking photos of the nests, one old bird not only allowed me to photograph it on the nest at a distance of seven feet, but appeared inclined to return to the eggs when the camera was placed directly over them. A Shore-Lark's nest, with three eggs half incubated, was on some very damp ground of the tundra, and a Red-throated Pipit's, with four fresh eggs, on a knoll in a marsh. While working round the lagoon, eight Bewick's Swans passed over



F. 44. 8 *S.* 3.45 *p.m.* 5-7-97.

LITTLE STINT ON NEST. *Tringa minuta.*

DOLGAJA BAY, WAÏGATCH.

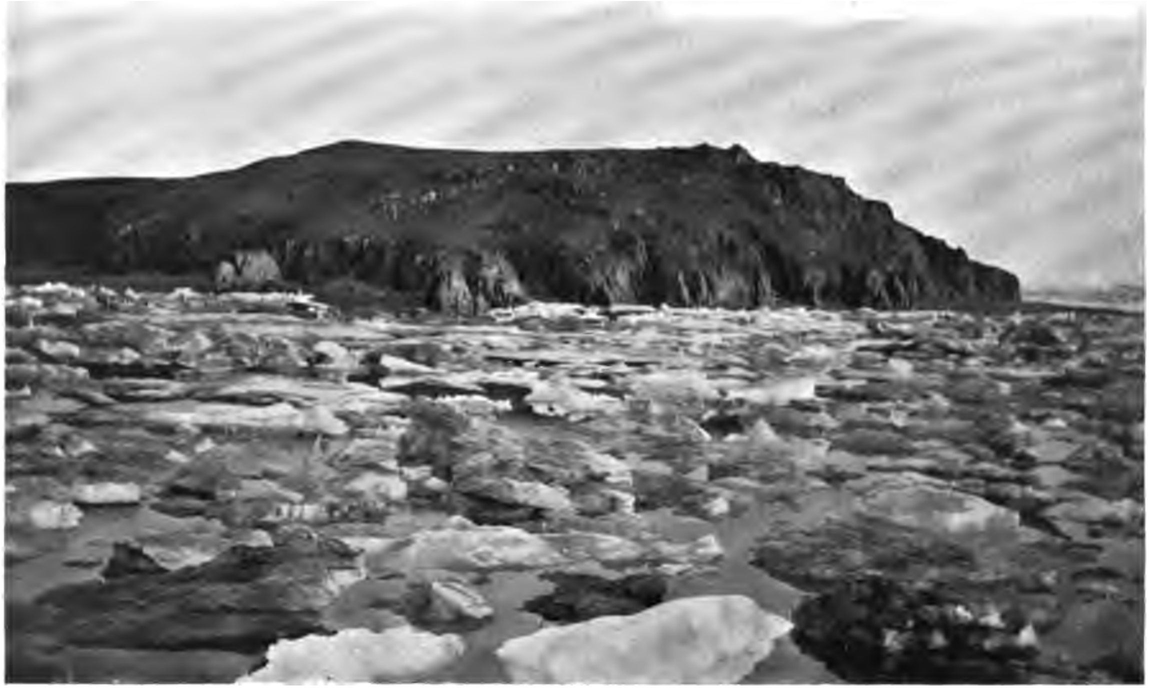
within one hundred yards, and we saw them well through our glasses. Soon after a White-tailed Eagle came even nearer, going towards some hills at the southern head of the valley. We followed in hopes we might find the eyrie there; but the hills proved farther off than we expected, and some fog coming on, we turned homeward at 7.15 P.M. Our party now consisted of Curtis, Harald, Johannes, and myself. Feilden had returned direct for the ship from the head of the bay accompanied by Pettersen, and Kjeldsen had gone back in the launch.

Before leaving the ship I had given the men strict orders to take a supply of food with them. To my annoyance, when we stopped for a snack at 8 P.M., I found that our two men had left theirs in the launch. Curtis and I had a small tin of potted meat, three captain's biscuits, and some chocolate; this to be divided amongst four, and our last square meal at breakfast! After walking two or three miles we sighted through the fog the head of the bay on our left; but saw also a large arm of the sea stretching right across our path, with a river entering it from the east, not marked on any map. Soon after making this disagreeable discovery we found a Snow-Bunting's nest in a peculiar position. We were following the course of a stream that had cut a bed for itself several feet deep in the mud and shale; at one point it had left a small pinnacle of harder material, three feet high, six inches wide at the top, and detached from the bank; on this little platform was the nest, with two young birds ready to fly and an addled egg. As in the case of the four nests of this species found yesterday, there was no apparent reason why the birds should select this site; the neighbouring rocks afforded cover for any number of nests.

We had to walk three or four miles to the east before we could wade through the river that barred our way. After crossing it, I made the mistake of continuing the course that Kjeldsen and I had decided upon before leaving, namely, two points west of north, without allowing for the long detour made. Some large lakes and marshes also forced us unconsciously into a considerably more easterly direction. We walked on through the fog, occasionally picking up a Little Stint's nest, the delay caused by blowing the eggs affording a welcome rest. At 1.30 A.M. I began to be anxious, as I felt sure we ought to have hit the coast near the *Laura* before this. It was impossible to see half-a-mile in any direction. To make matters worse, one seaman was certain the ship lay directly at right angles to the right of our course, and the other equally certain she was to the left. After wading for about a mile through more marsh, we crossed a stream, climbed a hill, the end of a long chain, and saw (the fog having cleared a little) a valley running down to the sea, closed by a high shingle bar like that in Dolgaja Bay, and beyond it the coast stretching a mile or more towards the north. This was not the coast near the *Laura*, nor any part of that we had seen when we visited Boronov Nos. Then where were we? Surely not on the east coast near Bolvanski Nos! We agreed the ship must be to the west or northwest, and so decided to cross the valley, first making a cache of all our gear except one gun. Finding two lots of Little Stints' eggs, we sucked them, and very refreshing they were, leaving a peculiar and slightly bitter taste in the mouth. The marsh had settled us rather, and we lay down under the lee of some rocks. After a short sleep we started again; but several more rests were required before we could accomplish the next three or four miles. Once more we came on the sea, and all felt sure we knew the coast this time. Half-an-hour after the masts of the *Laura* came in sight, and we were taken on board at 6 A.M.

Feilden and Pettersen were thrown three or four miles out of their course by the same arm of the sea which misled us, but having succeeded in crossing the river at its head, they returned to the coast. Four miles from the ship they heard the fog-horn, which Kjeldsen blew at frequent intervals through the night. This enabled them to take a shorter route, and they arrived safely on board at 10 P.M. Our absence was not the only cause of anxiety to those on the ship, for the ice-floes were drifting fast into the bay, and having

PLATE 28.



F. 11. 1 *S.* 2.10 *a.m* 8-7-97.

"LAURA ISLAND," DOLGAJA BAY.

WAÏGATCH.

packed all the lower part, were advancing on the *Laura*. At 4 A.M. things looked so serious, Feilden sent a good supply of food and our greatcoats on shore, in case a boat might not be able to reach us on our return.

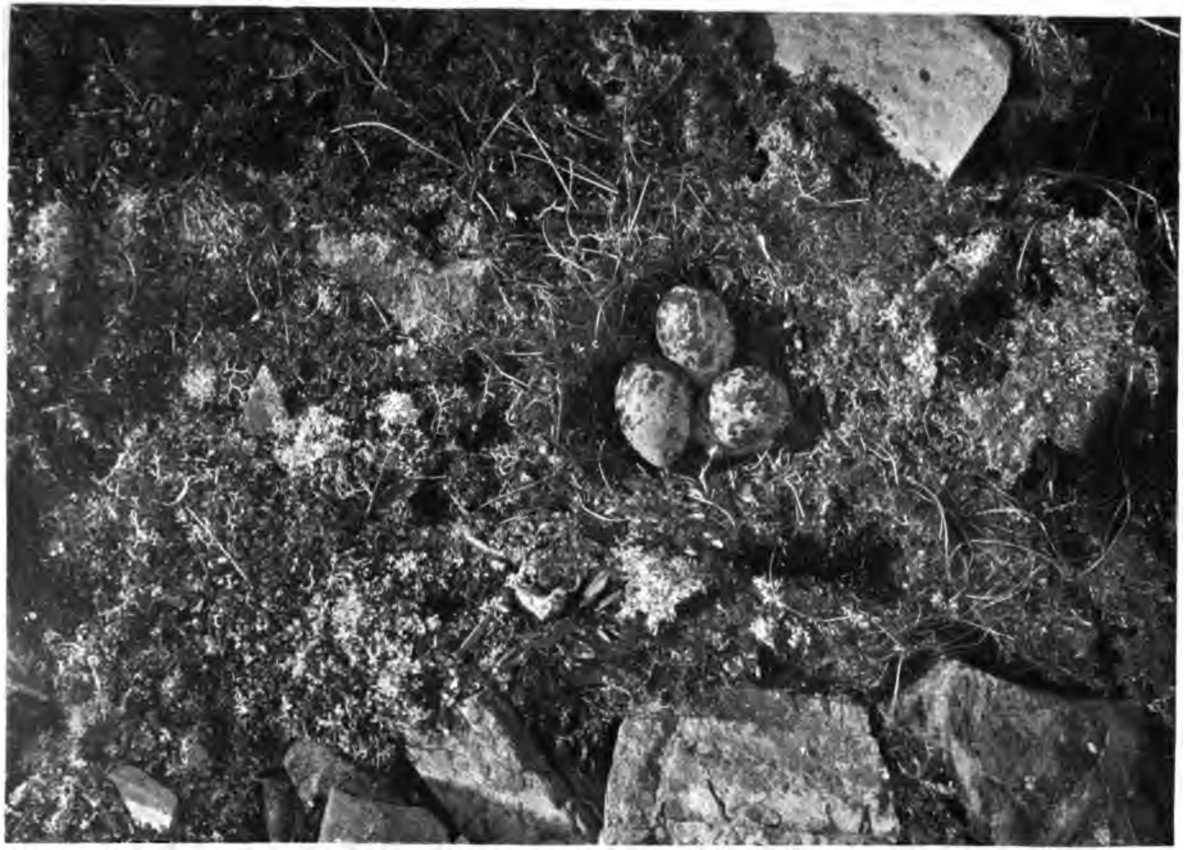
July 5.—Fog hung about in the earlier hours of the 5th, but it cleared soon after I landed, and I was able to take a number of photos of flowers and nests. Among the former, that of *Matricaria inodora* (Plate 77) will give some idea of the profusion with which flowers occasionally carpet the ground in these Arctic regions. Taking three men to Stint Lake, I worked through its marshes, and found there the Red-necked Phalarope's nest represented on Plate 25. It was on very wet ground; in fact, I sank down as I took the photo till I stood in nine inches of water. To-day a Little Stint eclipsed the previous performances of its species. I had arranged the camera vertically over the nest, and was about to photograph the eggs, when the old bird crept up through the grass, eyed the camera, its legs, and the black cloth fluttering in the breeze, somewhat doubtfully, and finally settled down on the nest, where it remained while I took two photographs. The result of one is given in Plate 27; the bird had not learnt to keep its head still, and spoilt the other. The nest was between the front legs of the camera. These eggs were fresh, so the parent's instinct to complete incubation did not come into play here.

I have never known any species of bird building on the ground whose nest is so easy to find as that of the Little Stint. Frequently we saw one rise hurriedly and disappear, to return in ten minutes by a zigzag flight and alight on some little knoll near; then, creeping through the grass like a mouse—it is wonderful how well the bird can hide in such slight cover—he or she settled on the nest with a little movement I can only liken to that of a lady arranging her dress in graceful order as she sits down.

The evening was a perfect specimen of what the Arctic region can produce in its happier moods. When we reached the shore at 8.15, the reflection of the *Laura* on the water was so clear I could scarcely tell which was the real ship on the glass of the camera.

July 6.—At 8 A.M. the temperature in the sun was 80°, in shade 61°, sea 40° (although much ice was round the ship). We started at 11 A.M. with three men towards the east, and, after crossing a considerable stretch of flat tundra, reached the ridge of hills seen on the 3rd. The hill we ascended was 200 feet above sea-level by aneroid. Here Feilden found several plants not recorded before from the island; and while I was taking photos of them and the scenery, he discovered the nest of a Dotterel, containing a clutch of three eggs, represented on Plate 29.

These ranges of hills are most interesting; they all appeared to be of slate, with the strata (or cleavage?) nearly perpendicular, and were generally in long continuous ridges like crinkles, rising above the surface of the tundra. Feilden pointed out two or three distinct terraces, or old beaches, showing the lines of upheaval. No hill in this part of the island was more than 250 feet high. Looking down on the country below, most of it appeared a beautiful green; but the whole of that green, whether on hillsides or in the valleys, was soft ground full of water, in which you sank to the top of shooting-boots. I never saw a piece of dry green ground on the island. Lakes and tarns were numerous, but they rarely contained any birds beyond an occasional pair of Long-tailed Ducks. We have only seen one pair of Divers yet on the scores of lakes visited, although several have passed over the bay. On leaving the hills we went down to the marsh below, and soon were busy among the Little Stints, finding four nests on the higher ground among the green and brown moss. Feilden then said he should return to the ship. We noticed he was a long time on the next hillside, and heard afterwards he had secured a Purple Sandpiper (male) and one young in down. He fully expected Daniel had caught the other young one seen. But no; Daniel stood placidly watching Feilden flit hither and thither over the rough tundra, and never thought of any such thing. A fuller knowledge of Norsk on his com-

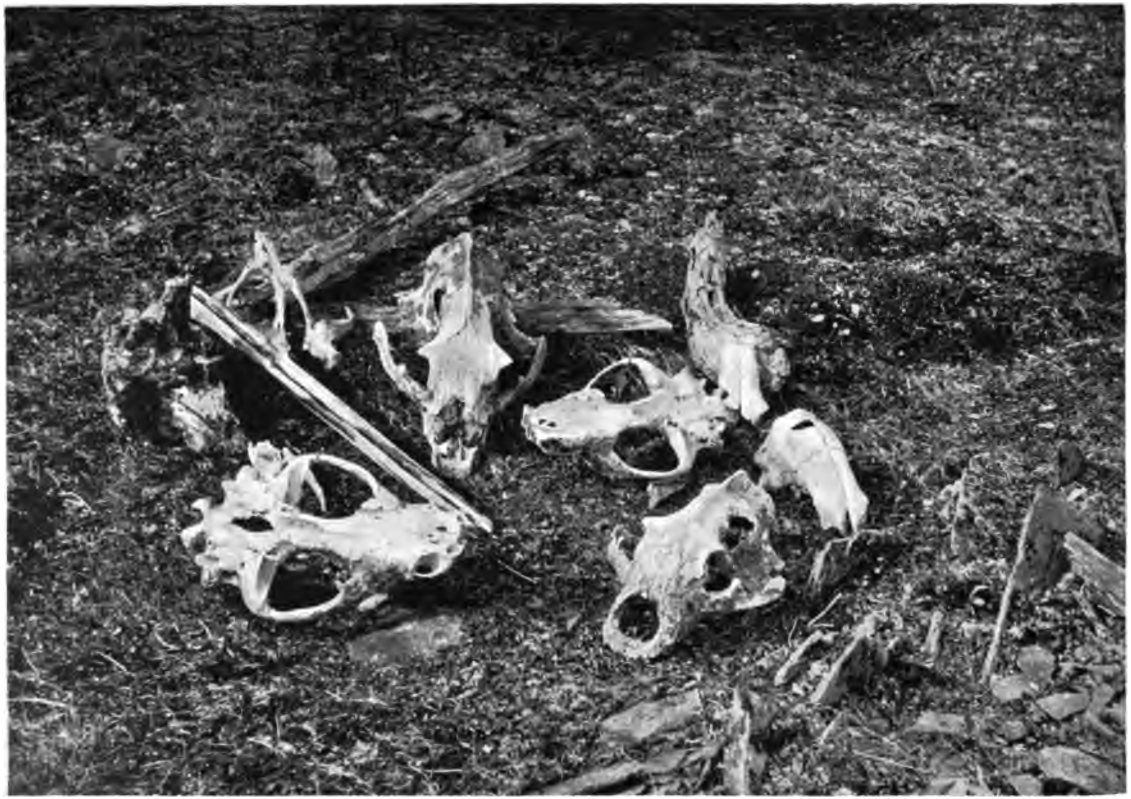


F. 64. 15 *S*. 5.30 *p.m.* 6-7-97.

DOTTEREL'S NEST, *Eudromias morinellus*

DOLGAJA BAY, WAÏGATCH

PLATE 30.



F. 64. 10 S. 2.45 *p.m.* 8-7-97.

ANCIENT SACRIFICIAL PLACE.

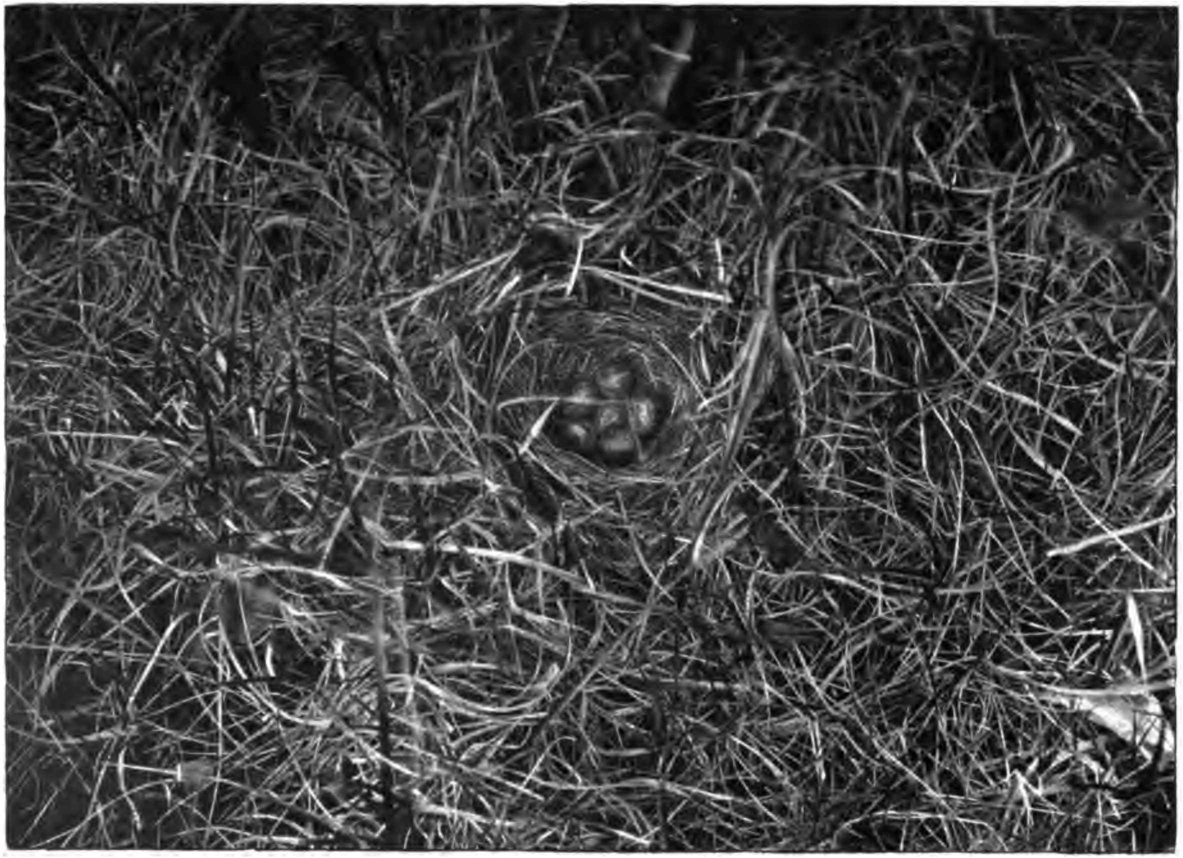
DOLGAJA BAY, WAÏGATCH.

panion's part would have given Daniel much food for after reflection. Only two things really make a Norwegian quite awake—a bear or a seal within killing distance; then you first realise what description of men these sons of the Northern Vikings really are. Feilden also found some finely coloured eggs of the Red-throated Pipit, the nest being well hidden in a Lemming burrow close to the water's edge; and two nests of Little Stints, both incubated. He reached the ship at 9 P.M. After he left, Curtis and I walked down to the shingle bar which separated the marsh from the sea, and soon found five more nests of Little Stints, all surrounded by grey grass bents and slate shingle, the latter so rubbed and scratched it was also a light-grey colour. Now, the first four found in the moss were among the richest coloured and most heavily blotched taken, while the five on the bar were all of a grey tone with fine brown spots. All the nests were within an area 400 or 500 yards long, and the birds were feeding together in the marsh. Either these birds knew beforehand the colour of their eggs, and selected a spot in harmony, or they were influenced by their surroundings in the coloration. I am inclined to think, from this and other observations, that the latter is sometimes the case, heterodox as I know the opinion to be. Three of these clutches are represented in the frontispiece, No. 1 being from the shingle bar, Nos. 2 and 3 from the moss. *N.B.*—It is to be hoped the system of illustrating single eggs in books on Oology will soon cease; it gives as little idea of the general characteristics of the eggs of a species as one obtains from some of the old collections composed of single eggs selected for their beauty or peculiarities.

While working round the marsh, I saw a Stint rise with a flight and note different to the others, and after watching some time, located the spot it was interested in; here were four young in down. The bird was very wild, but was shot at last, and proved to be a male Temminck's Stint, the first record of this species on Waïgatch. We then went to the top of a hill, where a Snowy Owl had sat most of the last ten hours, but there was no sign of a nest. We got on board at 10 P.M., well tired and ready for dinner. Dinner was also ready for us, as Christian, the cook, had taken to heart a lecture he had received the night before upon his habit of waiting till we were actually on board before he began making any preparations.

July 7.—Having decided the night before to make an effort to leave Dolgaja Bay, the anchor was up at 6 A.M., and we worked to the bay's mouth through the ice. On arriving there at 9 A.M., Kjeldsen reported from the mast-head he could see several miles of open water outside, but there was too much ice for the *Laura* to force her way through to it; so we ran into a small inlet on the west side, and anchored for a few hours to observe what movements were going on. It was a lovely day; temperature on deck in shade 70°, the sea at surface 40°; this the result of several observations; and the ice-floes around were melting rapidly under the combined influence of sea and air. But more came to take their place. In fact, the pack came into the bay so fast, that after waiting three hours we were obliged to retire to another bight higher up the west side of the bay. Before leaving, Kjeldsen again went to the mast-head; he reported the few miles of open water he had previously seen were now ice, and it extended to the horizon in all directions.

We soon found our best course was to regain our old anchorage at once, if possible; for the ice was advancing up the bay at the rate of two miles per hour, and gradually covering the whole area with a nearly solid pack. After a great deal of pushing and ramming, we at last got back at 6 P.M. The ice had closed up so much during our absence, it is no exaggeration to say we had some difficulty in finding a hole to drop the anchor through. This ice, which had been coming into the bay all day, was from the southern part of Barents Sea, and not from the Kara; it was "bay-ice," of one season's growth, much coated with mud and small stones up to the size of a man's fist, and was similar in all respects to that we had coasted along during June 27th and 28th. The evening and night were most lovely, with superb effects of colour over both ice and land, the sun shining brilliantly through the night. When we left the anchorage in the morning, the

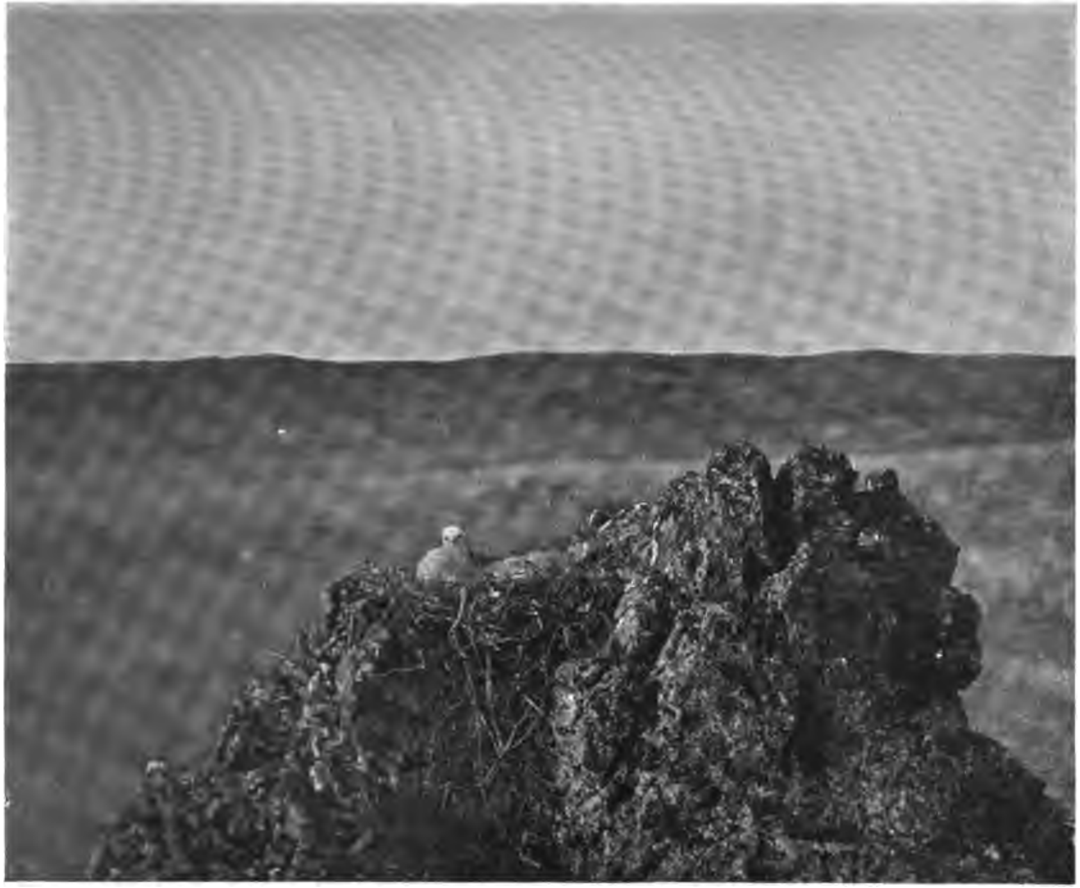


F. 64. 20 *S.* 3.35 *p.m.* 8-7-97.

RED-THROATED PIPIT'S NEST, *Anthus cervinus*

DOLGAJA BAY, WAÏGATCH.

PLATE 32.



F. 11. 1/5 *S.* 6 *p.m.* 8-7-97.

ROUGH LEGGED BUZZARD'S NEST, *Buteo lagopus.*

DOLGAJA BAY, WAÏGATCH

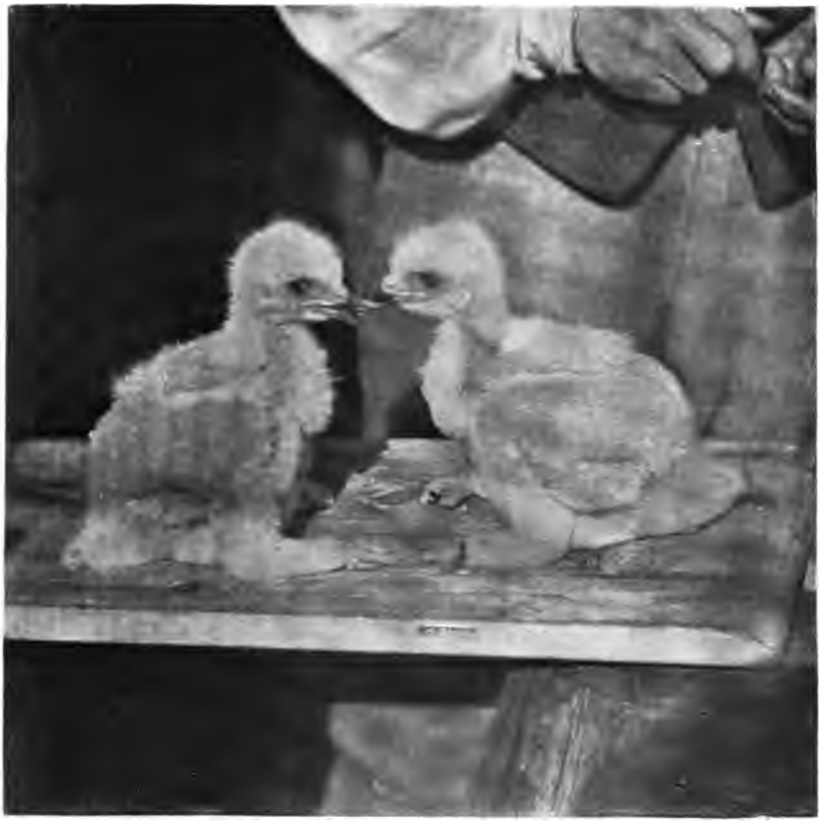
wind was east; at the mouth of the bay it was from the north, and on our return it was again east. The ice was coming up from the south-west.

July 8.—Leaving the ship after noon, an hour was occupied in getting the boat two hundred yards through the ice to the shore. Turning to the west down the coast, we discovered an ancient "Holy Place" of the Samoyeds on a knoll near the shore. This people resemble the original inhabitants of Great Britain and other northern countries in their habit of selecting islands off their coasts for purposes of worship and burial. The whole island of Waïgatch was a "Holy Land" in the olden days, and contained many of these places of worship, where the bones of animals killed in the chase were offered to their gods. Although the race are said to have been "converted" to the Greek Church, facts related by Mr. Trevor-Battye, and others afterwards discovered by ourselves, show the conversion to have been very much confined to the surface of their minds. Down below there is the ancient faith, only slightly affected by the Christian religion they are supposed to have adopted. The sacrificial pile, of which an illustration is given in Plate 30, consisted of four Ice-Bears' and two Reindeers' skulls, with other bones; all had plainly been undisturbed for a considerable time, from the lichens on them. The piece of stick shown is an old gunstock, which Kjeldsen picked up thirty yards off and added to the pile. Unfortunately the "god" was only found after the photo was taken; it lay among the moss and grass on the other side of the knoll, and consisted of a stick about two inches in diameter, with the upper end most rudely carved in a likeness of the human face; two round holes represented the eyes, a cross notch the mouth, and a longitudinal notch the nose. It was the custom to smear this "god" over the eyes, mouth, and nose with some of the blood of the animal killed, and to present the skull as an offering, but the remainder of the animal was taken for their own use.

After leaving the Holy Place, the men found a nest of the Red-throated Pipit containing six eggs, and illustrated on Plate 31. It was placed in grass six inches high, growing in a marsh; and although the latter was fairly dry, the nest was high up, lying quite open and exposed. This is the only time I have known the species select such a position, or one in which the nest could be photographed. The eggs were very uniform in colour, slightly marked, and agreed well with the dried grass surrounding them; they are the lightest coloured clutch in my collection. The same afternoon another nest of the same species was found within a mile of the previous one; it was in a hole six inches deep, and only just large enough to admit the bird; the four eggs it contained are the deepest coloured clutch collected in two seasons. Waïgatch is a country well suited to the Red-throated Pipit, and the birds were common in all parts visited. The nest is usually placed in the side of a hummock in swampy ground, and well concealed.

While Curtis and I were engaged in photographing the Pipit's nest, and also one of a Ringed Plover with four eggs on an old shingle bar fifty feet above sea-level, Feilden had gone on to investigate a ridge ahead. He had passed these hills in the fog on the night of the 3rd, and then felt sure he heard the cry of a Rough-legged Buzzard; he now found the nest, containing four young in their pretty coats of white down. It was most picturesquely placed on a detached pinnacle of rock, coloured with bright red lichen, and just large enough to afford a safe foundation. The nest was a bulky structure, 32 inches across and 12 inches in depth, made up of dried and dead willow stems (the largest half an inch thick), lined with grass, lichen, fragments of carex, bits of driftwood, old bones, lots of Snow-Buntings' feathers—evidently the chief food of the young—skeleton of a gosling, &c. The Plate 33 gives a poor impression of the nest, as the light was bad and the films had been changed, during a slight fall of rain, in that exasperating thing called a "changing bag." Two young ones were taken on board alive, and soon were general pets, as sailors dearly love to have some bird or animal on board. Plate 33 was taken on the 10th. I grieve to say the piece of flesh they are depicted fighting over is part of their mother, whom they lived on for a day

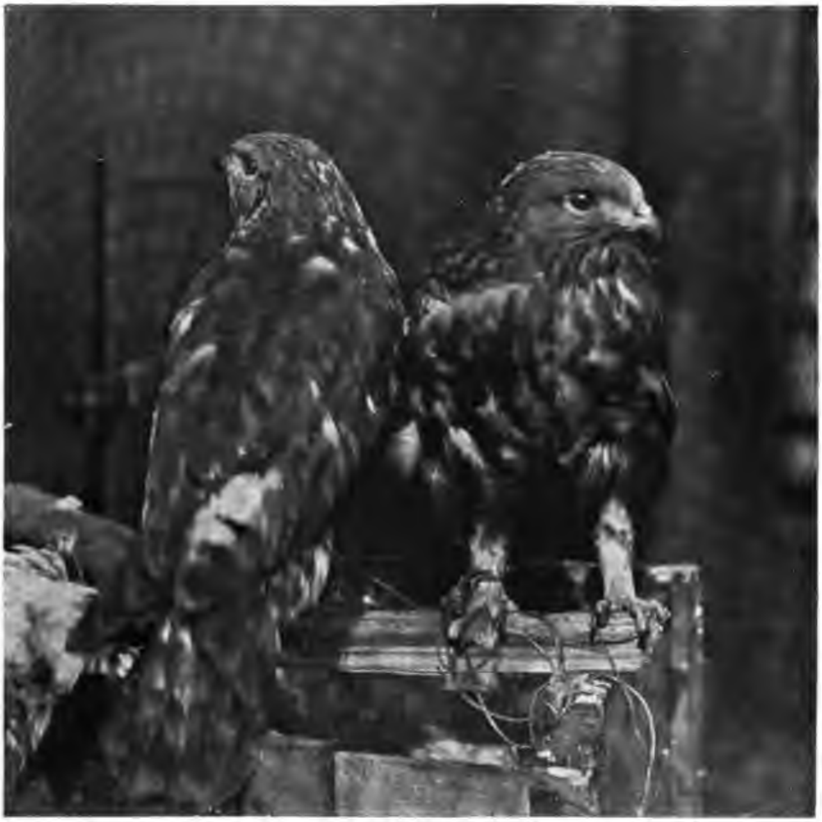
PLATE 33.



F. 11. 1/25 *S.* 4.20 *p.m.* 10-7-97.

YOUNG ROUGH-LEGGED BUZZARDS.

PLATE 34.



F. 11. 1/5 *S.* 2.30 *p.m.* 11-8-97.

YOUNG ROUGH-LEGGED BUZZARDS.

or two after her skin was removed. A far more gruesome scene is exhibited in a photograph taken near Spitsbergen by Mr. Arnold Pike, where he shows an Ice-Bear being eaten by her two cubs as she lies on the ice partly skinned.

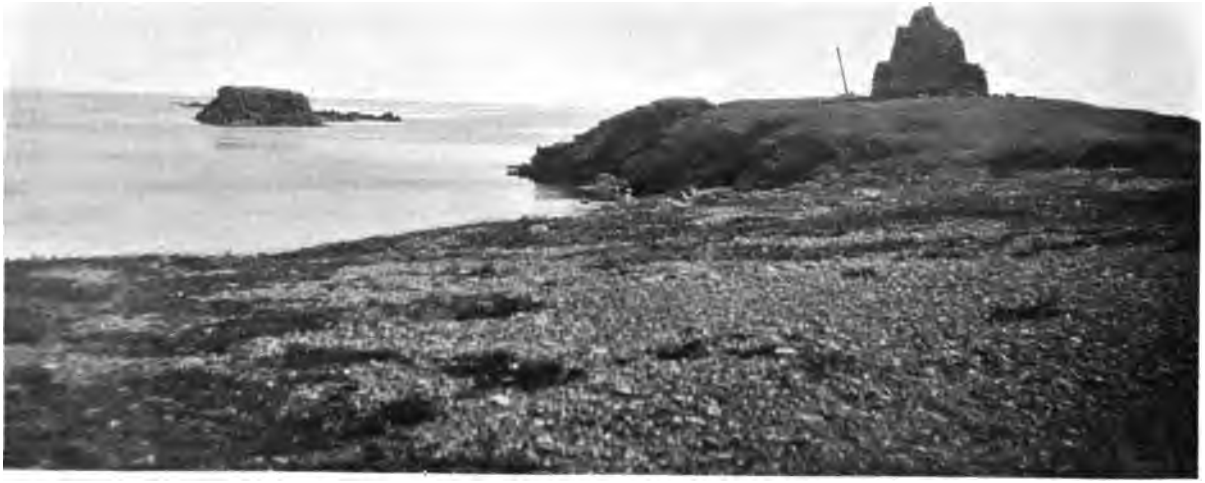
The progress of these two Buzzards was wonderfully rapid, as will be seen from Plate 34, taken on August 11, thirty-two days after Plate 33. During that short space of time they had assumed the full plumage of birds of the year. They were secured by a leather strap round the leg, to which a long piece of string was attached, giving them several yards of liberty. This state of affairs was only reached after a long battle between them and Feilden, for I have watched them study one of his best knots carefully, and then proceed to unpick it in a quiet methodical way that was most amusing. On reaching England, Feilden presented them to the Zoological Gardens, Regent's Park, where one has since died. As a third nest of this species was found near the shore of Dolgaja Bay, it must be considered common, for a bird of prey, on Waïgatch.

Leaving the Buzzard's nest, we went inland to a lake we had seen from the hill, but found nothing of interest beyond some lovely banks of flowers. At 8 P.M. we turned towards the ship. The weather had been hot and close all the afternoon, with a south-east wind, and now the heavens were covered with dense black clouds, the thunder growling in the east. At 9 P.M., when two miles from the ship, the storm broke over us, but fortunately its main body went down the centre of the bay. The sight was very fine, a deluge of rain falling over the sea, driven along by fierce squalls, which churned up both sea and ice, the clouds illumined by vivid flashes of lightning; then, even before the centre of the storm had reached the west side of the bay, a glorious double rainbow shone forth, its left base resting on Jackson Island—almost invisible in the deep gloom—and its right on the ice-floes round our ship. The whole formed a picture not easily forgotten.

We had again much trouble to force a passage through the ice to the ship, having constantly to jump out and drag the boat over the floes. One piece close to the ship's bow stood three feet above her bulwarks. Of course, when the light again allowed of photographing, that piece was gone!

July 9.—The ice having opened very much during the night, it was decided to make another attempt to leave Dolgaja Bay, and this time we succeeded. Starting at ten, we rounded the north-west headland of the bay at twelve, and steered for the south, where we encountered a dense fog.

A page of our summer cruise was thus closed, and on the whole the ten days composing it had proved most pleasant and productive. During that time we had shot or identified twenty-seven species of birds, besides a Linnet not determined. Among the above, four species—the Wheatear, Rough-legged Buzzard, Goosander, and Ruff—have not been previously recorded from this island. The Snow-Bunting is certainly the most common bird here; it is to be seen everywhere round the shores, on the fells, and feeding in almost every marsh. Next ranks the Little Stint, but locally distributed. Shore-larks and Red-throated Pipits are fairly numerous. Only three Wheatears were seen. While I was preparing to photograph the nest of the Rough-legged Buzzard on the 8th, a Wheatear came and hovered a yard above it, apparently interested in its contents; a dangerous position without our protecting presence. Lapland Buntings were met with, chiefly on the west side of the bay, and appeared to be rare on our side. We saw about a dozen Reeves and five or six Ruffs. Dotterels were common in parts, often three or four together, but sometimes we passed over miles of country without meeting one; and as we walked in a line of four to seven men, a considerable area was covered. Ringed Plovers were plentiful in all localities suitable for breeding, and had generally hatched off. Red-necked Phalaropes were often seen. Long-tailed Ducks were common both on the coast and the lakes, and Common Eiders were plentiful on the coast. We saw no King-Eiders. The Geese were nearly as wild as in England; the only species identified



F 11. $\frac{1}{25}$ *S.* 2.30 *p.m.* 11-7-97.

CAPE GREBEN, WAÏGATCH.

being the Bean-Goose. We saw no sign of Swan or Goose nest, beyond the egg-shells left by the Samoyeds at Boronov Nos. Dunlins were scarce, only ten or twelve pairs being seen.

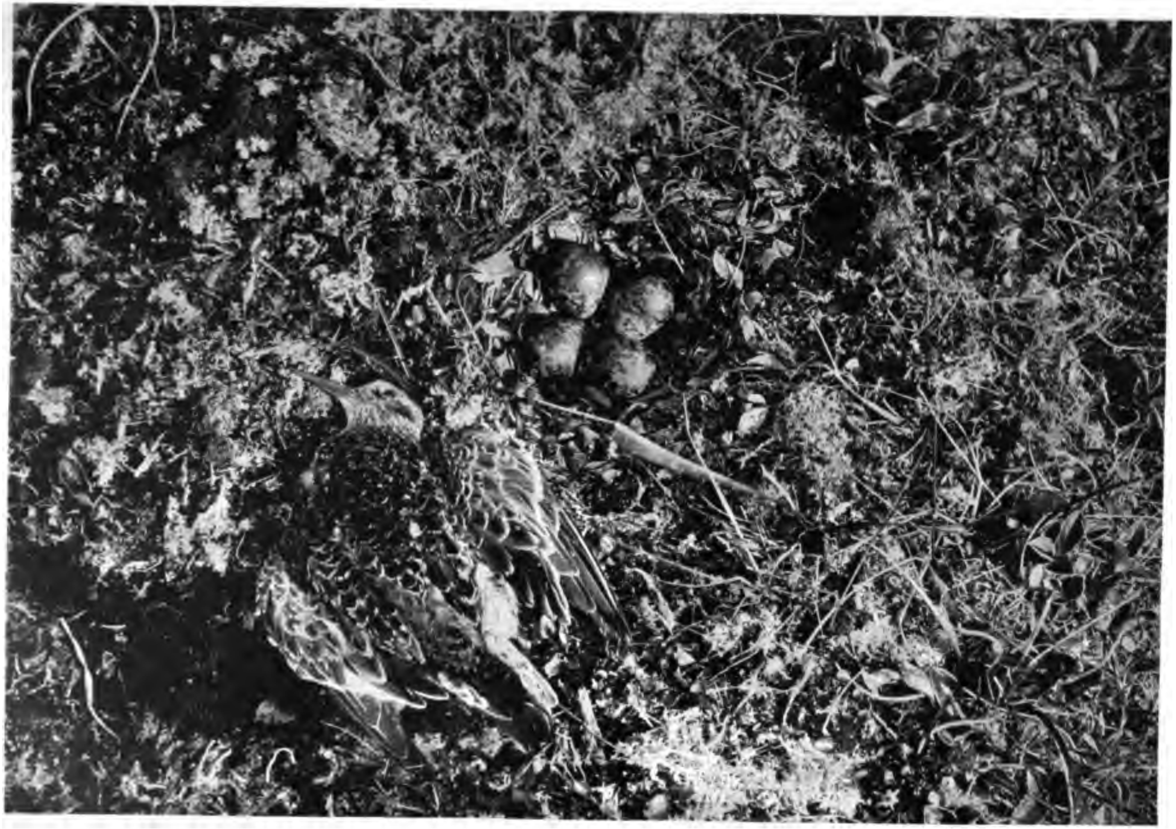
And now let me again impress on any future visitor to Waïgatch the fact that there is no safe anchorage on the west side of the island between Kara and Yugor Straits, even in Dolgaja Bay, except that we found behind our island on the east side of the bay; and even there I think it possible the ice may cause trouble at times for ships of ordinary build. Indeed, there is no such thing as a really safe anchorage in all these seas before the summer has finally destroyed the ice. Kjeldsen carefully explored Dolgaja Bay in the launch while we were at work on the shore, and the above is his verdict. He also impressed on me that no ship ought to attempt to pass up the bay beyond Jackson Island. The currents and tides bring both Kara and Barents Sea ice into Dolgaja Bay at times with great rapidity, for I have seen it filled from end to end in twelve hours, and its total length is quite fifteen miles.

CHAPTER VII

WAÏGATCH, HABAROVA, AND DOLGOI

AFTER this slight summary I must return to the fog, for the very good reason that it declined to leave us that day! We worked slowly down towards the south-east through considerable quantities of ice—fortunately in "open order"—till 10 P.M., when we decided to lay-to. It is trying work to make your way under such circumstances down a practically uncharted coast, without known headlands, looking for an anchorage. At 1 A.M. next morning the fog lifted enough to show that a strong north-west current had drifted us back to the latitude of Osminina Bay, obliging us to use steam again.

July 10.—It was not till 4 P.M. the next day that we could distinguish the coast clearly, when we saw we were outside Liamshina Bay, and at once steered into it, making for the mouth of the Talata River at half-speed. As soon as we approached the line of the outside headlands the engines were brought to "dead slow," and casts with the lead frequently made. When we had proceeded some distance into the bay, Hansen, who had charge of the lead, sang out, "Seven fathoms, six fathoms, three and a half fathoms, two and a half fathoms." Directly after came the long grating sound of the ship going on to a rock. Most fortunately the weather was perfect, sea like glass, and the ice—a heavy pack on our port side—asleep; not a floe moved. We soon found the engines were quite unable to get the *Laura* off, and, at Feilden's suggestion, I ordered steam to be got up in the launch to assist them. While this was being done, the crew lowered the boats and put the chain-cables into them, relieving the ship of some tons of weight. Happily we had taken the ground



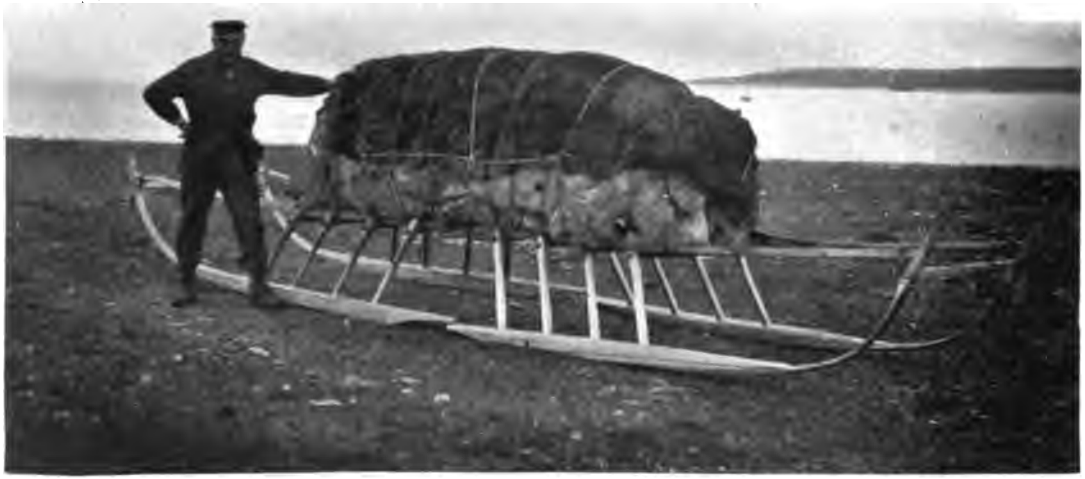
F 64. 15 *S.* 4.30 *p.m.*

PURPLE SANDPIPER'S NEST, *Tringa striata.*

11-7-97.

CAPE GREBEN, WAÏGATCH.

Plate 37.



F. 11. 1 *S.* 2.30 *p.m.* 12-7-97.

TWO SAMOYED SLEDGES NEAR CAPE GREBEN AND KJELDSEN.

before high tide, and the water rose four inches afterwards. When all was ready, a united effort of the engines, and launch tugging on the kedge-anchor, took the ship off the ledge, after considerable effort and without damage, much to our delight. We had feared we should be obliged to sacrifice part of our coal to get her afloat, a most serious catastrophe in these regions. At the time we took the ground we were a mile from the nearest shore on the port (south) side and three miles from the mouth of the Talata River ahead.

We had scarcely completed the re-shipment of boats and cables when the fog again closed round us, entirely shutting off all view of the land. A word of praise is due here to the crew, who worked with a will. Feilden, who has a much larger experience than myself, says he never sailed with a better set of men.

July 11.—Kjeldsen was up all night working down the coast through the fog, and brought the *Laura* to anchor in Benaude Bay, to the east of Cape Greben, in three and a half fathoms. He had found the soundings taken during the last twenty-four hours much shallower than those marked on our charts.

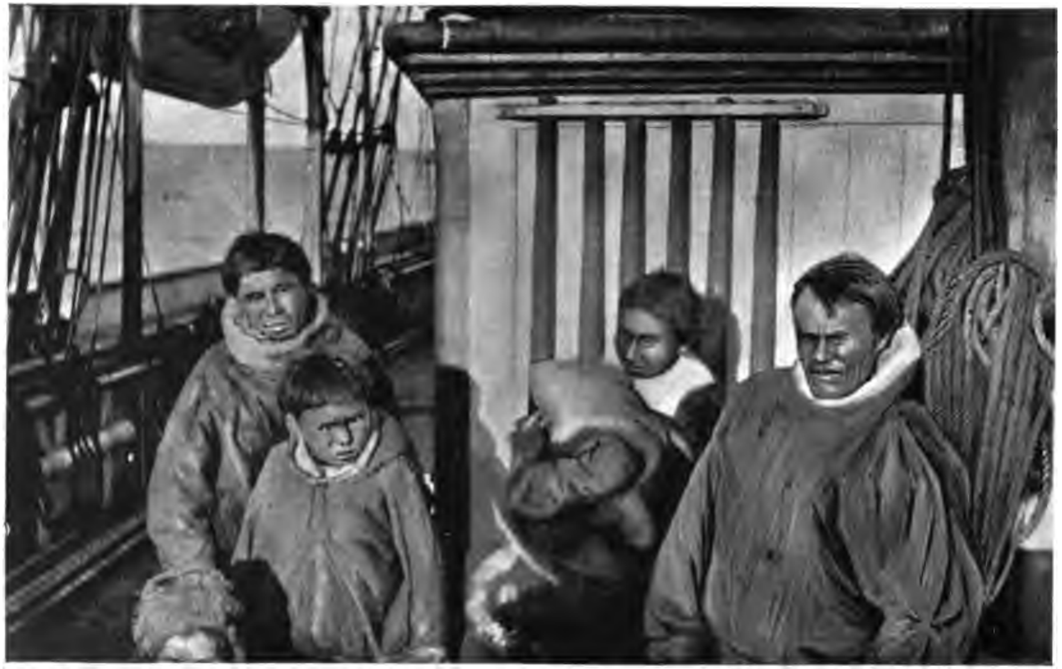
Divine service in the forenoon was only attended by three of the crew, most of them being still in their bunks after the exertions of yesterday. At mid-day the sun had dispersed the fog and clouds, raising the temperature to 60° in the shade on deck; so after lunch we went in the launch to Cape Greben, and enjoyed a lovely afternoon, the only drawback being the attentions of small clouds of mosquitoes. We walked down to the point to examine a large pile of stones erected by the Russians as a beacon for the entrance of Yugor Straits, and learnt from an inscription it was built—or rebuilt—in 1893. Nordenskiöld describes and figures a very fine ancient sacrificial place with a large collection of horns and skulls, which he saw on this headland in 1878 (see "Voyage of the Vega," vol. i. p. 91). During the construction of the beacon in 1893 the settlement was visited by a Russian Pope with strong views respecting these idolatrous remains, and he made a great bonfire of the whole; now not a trace is left. Of this more anon.

The tundra on this south-west part of the island is much flatter than that about Dolgaja Bay, and has more grass on it. What struck us most was the wonderful wealth and profusion of flowers, especially near the coast. Broad stretches of colour covered large areas, not like the pretty little "Arctic Gardens" of Kolguev and the northern part of Waïgatch. Combined with a powerful sun-heat, the flowers made it very difficult to realise we were not in some favoured temperate clime. Plate 79 represents very faintly a little gem among the many beautiful spots. Its centre is filled with the lovely lilac-coloured flowers of *Primula farinosa,* the large white flowers are *Matricaria inodora,* and the clumped masses of flowerlets to the right *Pachypleurum aplinum.* Near the above, but on very different ground, I took a photograph of a white *Silene acaulis* (Plate 80); this is chiefly interesting as illustrating on a small scale the formation of hexagonal mud patches by frost. The beautiful white of the flowers stood out in vivid contrast to the hard mud on which they grew.

Plate 85 gives part of the coast a mile to the north-west of Cape Greben, and shows well the perpendicular character or cleavage of the strata. On Plate 86 is a group of ice-polished mamillated rocks; they were situated some two miles from the sea, at an elevation of fifty feet above it, and stood twelve feet above the surrounding land; the surfaces were scarcely weathered, and as smooth as if recently worked by a mason.

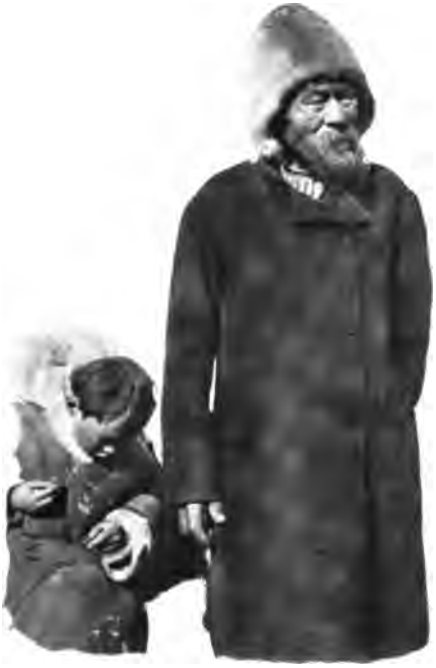
Birds were certainly more numerous here than in the northern parts we had visited. Snow-Buntings and their young were plentiful; Lapland Buntings, Shore-Larks, Red-throated Pipits, often seen; a Linnet (species uncertain) and a Wheatear passed us. Dotterels, Ringed Plovers, Purple Sandpipers, Little Stints, Temminck's Stints, Red-necked Phalaropes, all had young, although eggs of some of the species were found. One or two Golden Plovers were seen; several Reeves appeared very

PLATE 38.



F. 11. 3/4 *S.* 8.20 *p.m.* 11-7-97.

SAMOYED GROUP ON BOARD AT CAPE GREBEN.



OLD SAMOYED AND BOY AT HABAROVA.

(FROM PHOTOGRAPH BY MR. F CURTIS.)

anxious about something—young, we thought. Long-tailed Ducks were very common; we saw sixty or seventy of them; also a few Red-breasted Mergansers: while two or three Snowy Owls quietly watched us till we approached within a hundred yards, when they lazily flapped to the next hill. The only nest found worthy of note was that of a Purple Sandpiper with four eggs nearly fresh. Curtis put the male off the nest and shot him; so I laid him down by the nest and photographed the group. (See Plate 36.) Feilden had often found the nests of this species on the Faroes and other places—it was new to us—but I expect he will remember this as long as any, for I called, saying we had found the nest of a Purple Sandpiper, and he understood me a Curlew Sandpiper!! Alas, that blue ribbon of the oological world was not for us!! It had already been secured eight days before on the Yenisei by my friend Mr. Popham, who has done so much good field-work among the rarer Arctic birds in their breeding season.

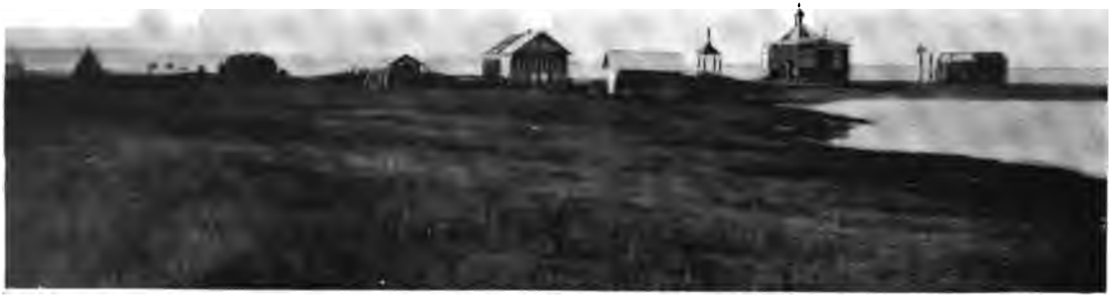
That was a glorious afternoon at Cape Greben. The brilliant sunshine and clear atmosphere made everything beautiful, and new objects of interest presented themselves at every turn. The heat was enough to make walking in Arctic summer clothes very warm work. Suddenly about six o'clock a change came, dense fog rolled in from the sea, insects disappeared, flowers closed, and we, wet and almost shivering, made our way back on board as quickly as possible. In ten minutes we seemed to have passed into another country, and certainly a different climate. It is never safe to dress suitably for a hot day in these parts. However uncomfortable you may be, grin and bear it, for it is most probable you will be glad to possess every garment long before you reach camp or ship.

On reaching the ship, we found a whole family—three generations—of Samoyeds there, who had crossed from the mainland. They were a dirty party, and it did not need a close inspection to see that insect life was abundant on some of them. I gave the father a tin of "chay" (tea), and he presented me in return with some fine *Salmo alpinus* and *Salmo omyl*, a number of which lay in the bottom of their boat. By the time our meal was finished the fog had cleared off, and we obtained some rather dim photographs of the party in the evening sunlight (see Plate 38).

Curtis and I landed again that evening, but found little of interest. There was one curious incident. We had secured a family of Temminck's Stint in a very youthful state of down, and I was busy opening the knapsack for their reception, the old bird remonstrating strongly, when Curtis captured three Little Stints. The latter proved so active, I left the Temmincks in my cap, and proceeded to fasten labels to the legs of the Little Stints. No. 1 immediately walked off with its label, and when it got six feet away, the old Temminck came and brooded it, but with many an anxious glance at me and at that label sticking out from under its breast. I have never before known the Temminck show such boldness in defence of the young. On all other occasions it has retired to what it considered a safe distance, or disappeared. The Little Stint was only a few feet farther off, and it did not resent the appropriation of its young. Though we did not shoot either of the birds, there could be no mistake in the identification at that distance.

We got back on board at midnight, and found a basin of soup very comforting after our tramp. How often similar entries occur in my diaries. Tinned soups of the best quality are most useful on a voyage, and they are always ready in ten to fifteen minutes, even when boiled over a spirit-lamp. This latter point is a great consideration, especially in a country like Iceland, where we never saw a fire for weeks together. We used there a small French lamp, costing two shillings and sixpence, which cooked all the food required by my brother and myself, and burned only two gallons of spirits of wine in six weeks.

July 12.—Rounding the headland to the east of our anchorage, we entered another bay not shown in the charts, and too shallow to admit a ship of the lightest draught at any part between its headlands. We found only two fathoms two miles from shore. There



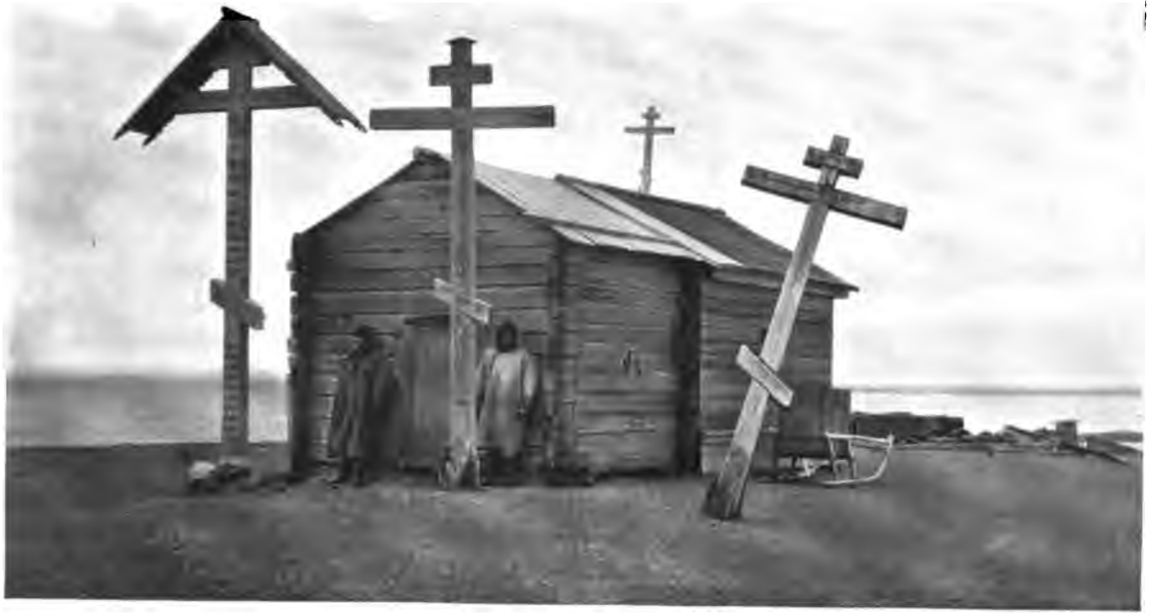
F. 11. 1/2 *S.* 7.20 *p.m.* 17-7-97.

HABAROVA.

are three large bays near Cape Greben. One to the north of the cape opens towards the south-west, and runs up in a north-east direction; the second, in which we anchored, faces south-east, running inland towards the north-west; and the third, to the east of No. 2, has no "hinterland." The first two are typical Waïgatch bays, with heavy shingle bars at their heads, bearing traces of several elevated beaches, and having large marshes behind, separated from each other by half a mile of higher ground. I was struck by the fact that in all these bays on Waïgatch, whether they run from south to north or north to south, the river has pierced the shingle bar on the west side. We found no good drinking-water near either bay—a disappointment, for the tanks were getting very low. Three lots of young Dotterel in down were caught. They are very pretty in this stage of their existence. Of seven Dotterels taking charge of the eggs or young this year, five were males. The remains of five Snowy Owls were mixed with those of Geese, Ducks, &c., on the site of a recent Samoyed encampment. There were also a number of reindeer bones, most of which had been split to extract the marrow.

Returning on board, I decided to go to Habarova, on the other side of the Straits, as I was anxious to obtain all the information possible about the country we proposed to visit. The passage up the Straits occupied two hours with tide in our favour, and we dropped anchor a mile from shore in 5½ fathoms.

July 13.—No place on the shores of the Northern Seas is better known by name than Habarova; for, situated in the Yugor Straits, it has long been a place of call for all vessels attempting to enter the Kara Sea, or to penetrate along the ice-blocked coast of Siberia, and the great rivers flowing through it into the Eastern Arctic Ocean. Certainly it would be difficult to find another "town" with such world-wide reputation and fewer habitations; for nearly the whole place is represented in Plate 40. The situation was doubtless originally chosen by the Russians for a settlement on account of the lagoon seen on the right side of the picture, which is the tidal estuary of the Nikolski River. This lagoon is separated from the sea by a high shingle bar, which the river has pierced by an opening some fifty feet wide and five or six feet deep at high tide. Through this opening their small ships or lodkas are able to pass, and find an anchorage secure from ice and the heaviest storms which visit this wind-swept country. When I state we never saw any place in Novaya Zemlya or Waïgatch affording so safe a refuge for this class of vessel, the choice of the Russians is easily understood. Taking the buildings in order from the right, the first is the old church, a very primitive wooden building, illustrated on a larger scale in Plate 41. The fore part is a porch, rather out of proportion to the main building, from which it is divided by a door and partition, for the porch measured 10 feet by 10 feet, and the church 14 by 13. At the east end of the latter are five large ikons, and in front of them five candles, worthy, as to size, of a Roman Catholic cathedral. I believe a Pope generally visits the settlement for two or three weeks in the summer, to baptize the newly arrived small inhabitants, and hold a series of services in the churches, but the funerals and marriages can scarcely wait his advent. The next building is the new church, Plate 42, erected in 1885 by the wealthy Russian merchant Sidoroff, as a thank-offering for his escape during a terrible storm on his return from the Yenisei; its roof was painted a brilliant green, and its wooden walls partly a yellow ochre and partly dull red. Unfortunately the doors were securely boarded up, for the priest was not expected till some three weeks after, so we did not see the interior. The bells were hung in a separate building on the left. Next to the belfry is the bath-house, constructed on the Russian system, and evidently in constant use, for the Russian merchants here were as fresh, clean, wholesome-looking men as the average Englishman. Then comes the Pope's house, dating from 1882, a large substantial building, with plenty of good-sized windows, and superior in all respects to the other houses in the place. This was intended as a monastery—doubtless for the spiritual welfare of the Samoyeds—and six monks were placed there originally; all died of

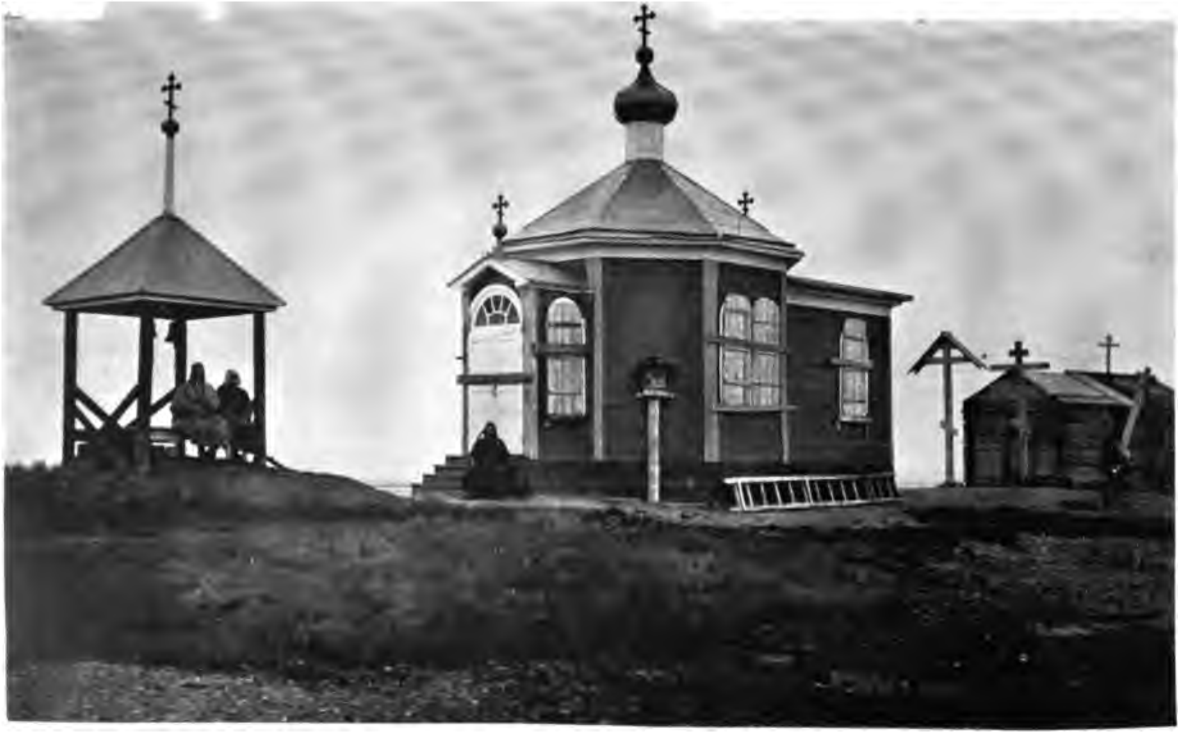


F. II. I *S.* 3 *p.m.*

13-7-97.

OLD CHURCH. HABAROVA.

PLATE 42.



F. 11. 1 *S.* 3.15 *p.m.* 13-7-97.

NEW CHURCH AND BELFRY HABAROVA.

scurvy during the two first winters, and their places still remain vacant. Their bodies repose side by side upon the tundra near the lagoon, enclosed by a framework of wooden planks, and protected in the same manner on the top; at each man's foot is a tablet bearing his name and other particulars.

The water supply of Habarova is derived from a small spring rising in a marsh near the bath-house, and surrounded by every conceivable filth and abomination. That spring was the cause of the only sharp discussion with Kjeldsen I ever had, for he wanted to fill the water-tanks there. I should as soon have thought of drinking from the overflow of a sewage farm purified on the latest chemical principles. It is often very difficult to obtain a supply of good water in these countries; but take anything rather than the most tempting-looking stream in the neighbourhood of a settlement.

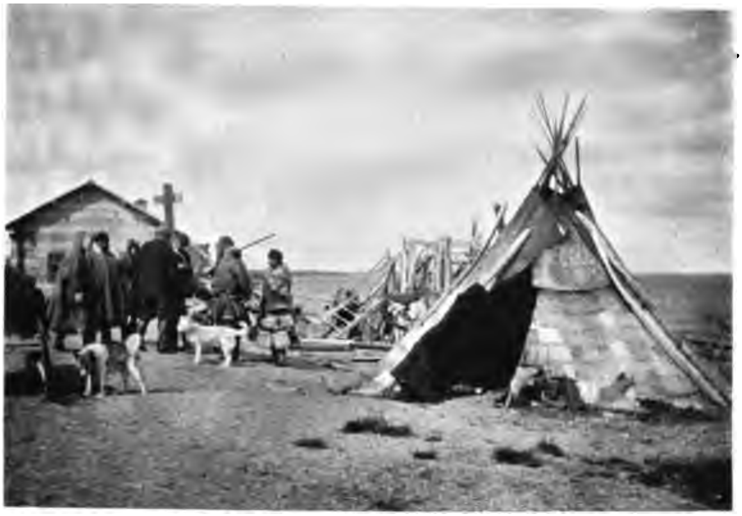
To the left of the Pope's house are four or five much smaller wooden houses, occupied by the Russian merchants, most of them being to the west of the part included in Plate 40. The Samoyed attendants live in chooms on the single beach, one of which is depicted in Plate 43A. Some of these chooms are constructed of birch-bark beautifully sewn together; others of skins like that we saw in 1895 on Novaya Zemlya. The former speak of the annual migration to a country where trees can grow; for only part of the Samoyeds remain at Habarova during the winter, the others accompany their masters.

As soon as the autumn frosts have made the bogs and rivers passable, and enough snow has fallen to make sledging good, the Russians pack up the results of their summer trading and start on their long drive to Pustozersk and other towns on the Petchora, a journey occupying about four weeks, under favourable circumstances. Here are their homes, and here the wives remain with the younger children during the summer. In the winter the men journey to various markets to dispose of their skins, and lay in supplies for the following summer's trading. And so the cycle of life goes on generation after generation, a hard rough life, but a healthy one, judging from the Russians we met, who were a fine set of men. What a contrast between them and the results of civilisation as seen in our large towns! Most of the men at Habarova belonged to the sect of the Old Believers, and did not use tobacco in any form. It is a point they appear to be very strict about. Several of them also declined spirits, although they were glad to have a glass of port wine.

The morning, and in fact the whole day, was wet and uncomfortable, with half a gale from the west, quite enough to make us glad to be in a fairly sheltered anchorage. Soon after breakfast Ivan Alexandrovitch Koshevin, the principal merchant in Habarova, came to call upon us, accompanied by his son. Both were fine, handsome men, six feet high, the father with dark, almost black hair, and the son's of a light sandy colour. They were dressed in skin caps, long coats with no opening in front, made of some dark brown twill lined with fur, and with fur collar and cuffs, trousers, and long leather boots reaching to the top of the thigh. We had much talk with them through Pettersen, but soon found they could give us no information whatever upon the point which was to us all-important, namely, the probability of the *Laura* being able to enter Khapidirsh Bay, and take us near enough to land at the mouth of any of the rivers. They explained that the bay was bad for ships, and the ice remained there so long in all ordinary seasons that they never tried to enter it from the sea. All they knew of the country was learnt during their spring and autumn journeys overland along the coast. They could not even tell us whether the launch, drawing three feet, could pass over the bar at the mouth of the Karataikha River, the largest river in this district. All this was unsatisfactory and foreboded trouble to come.

I showed them a series of coloured drawings of birds likely to occur in these regions, copied from Dresser's "Birds of Europe." The son at once recognised the Bewick's Swan and Bean Goose, saying he had shot them on Waïgatch. He pointed out the differences between the various geese and swans he knew, and told us the White-fronted

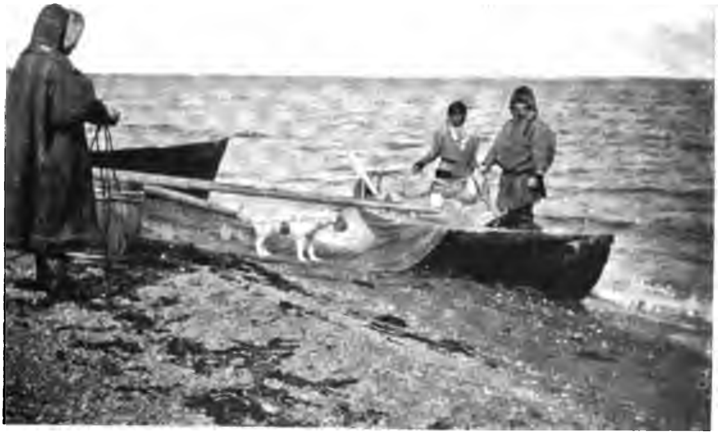
PLATE 43 A.



SAMOYED CHOOM AT HABAROVA.

FROM PHOTOGRAPH BY MR. F. CURTIS.

PLATE 43 B.



SAMOYEDS FISHING AT HABAROVA.

FROM PHOTOGRAPH BY MR. F. CURTIS.

Goose and Black Scoter were common on the Petchora; also that the King-Eider was the eider breeding on Dolgoi Island, and the Common Eider inhabited Waïgatch. The Red-breasted Goose was unknown to him. While he had a good knowledge of all birds large enough to be useful for the pot, he could tell us nothing respecting the small birds, and in fact scarcely recognised them.

He said the ice left the shores earlier this year than it had ever done either in his or his father's recollection; so much earlier in fact than they expected, that a quantity of stores they had left on the ice when crossing the south end of Khapidirsh Bay had been carried out to sea. We learnt from him that Lemmings were very scarce this year, which accounts for our not having found any nests of the Snowy Owl.

After lunch we went on shore and returned the call, being received in a small but clean room 14 feet by 12 feet, with a brick stove in one corner, two bunks in another, and benches running round the intervening wall space. On the walls were a number of photographs and coloured pictures of the Tsar, saints, &c. We were regaled with tea, the real overland Russian tea, a straw-coloured liquid, delicious, and sweetened with sugar-candy! The resources of the establishment were somewhat strained to provide drinking utensils, as every Russian had come in who could find standing-room; but each cup or glass was carefully wiped before the tea was poured in, on a clean white towel, washed last, I am certain, in the far-off home on the Petchora River. Ivan showed us with pride a gold medal bearing the effigy of our Queen, presented to him by the British Government for services to British subjects. The aid he had rendered to Captain Wiggins and his shipwrecked crew, in taking them from Habarova to Pustozersk on his reindeer sledges in 1894, was the chief reason for his receiving this handsome decoration.

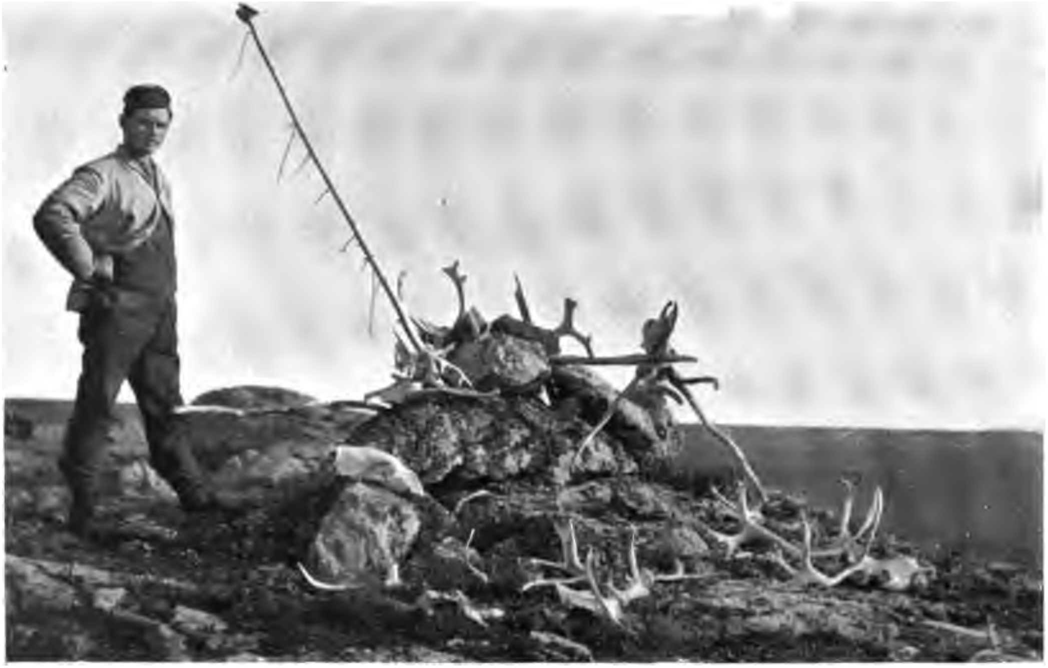
Ivan afterwards took us to a large wooden warehouse, erected by Sidoroff in expectation of the probable trade between Russia and the rivers of Siberia by this route. On the ground-floor was the whaling-boat, given by Mr. Popham of the *Blencathra* to Mr. F. G. Jackson; and in an upper storey hung twelve skins of ice-bears, shot by the Samoyeds last winter. I bought one of the largest for £10; when finally dressed and cured, it measured 8 feet by 8 feet.

We were told that a lodka would sail for the Petchora in one or two days, and Ivan kindly offered to send our letters by it; so both we and the crew were busy most of the evening in "writing home." These letters arrived in England two or three weeks after we did!—a fair picture of the difficulties of communication in these northern regions.

July 14.—Drinking-water now becoming a pressing matter, Kjeldsen and I, with two men, took the launch to the east to see if we could obtain a supply from the River Oya; but, after steaming some distance, we found the attempt hopeless, for, when two miles from the islands near its mouth, there was only five feet of water, scarcely enough in a choppy sea with a boat drawing three feet. To the north, reefs or banks came nearly to the surface, and no deeper water could be found on the south side between us and the shore, quite a mile distant, obliging us to return to the ship. All the charts published of this district are far from accurate.

After lunch I took Kjeldsen and four men in the launch to Habarova to get water for the boiler, and thus economise that in the tanks. Whilst the barrels were being filled, Hansen and I walked up the Nikolski River, and found it tidal for two miles from the sea. That part of the river is nearly straight, running due north; but the course bent sharply to the east for some distance from where the tide ceased to influence, and then came from a south-east direction. A Reeve with an anxious air was seen near the river, and after ten minutes' search I secured a young one partly feathered, the first we have met with this trip. Next, four young in down of Temminck's Stint were found a few yards from the water; they had been recently hatched. This species has a decidedly yellow tone of colour on the tips of the down, which is replaced in the Little Stint by burnt sienna.

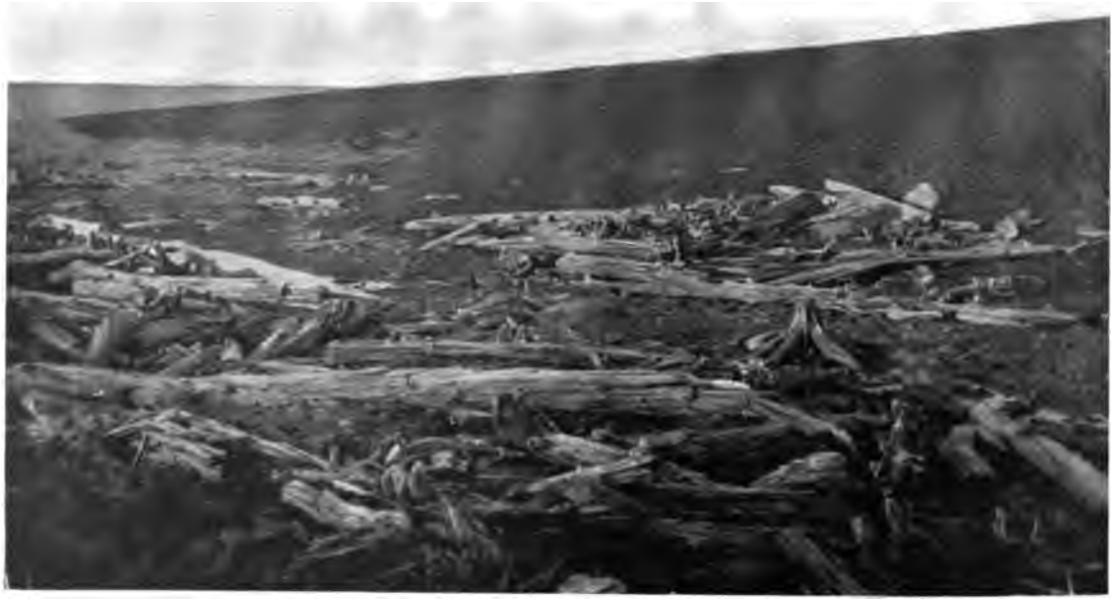
PLATE 44.



F. II. 1/5 *S.* 5.55 *p.m.* 18-7-97.

RECENT SACRIFICIAL PILE, CAPE MATI NSELA.

Plate 45.



F. 11 1 *S.* 7.15 *p.m.* 18-7-97.

DRIFT WOOD, NEAR CAPE MATINSELA.

A mile farther on, Hansen called me to a lovely nest, made of fine twigs and grass outside, lined with flower-seeds and two feathers of the Snowy Owl. It contained three eggs, and was placed in a little bush of dwarf-sallow, which only measured 6 inches in height and 18 inches through. After waiting half-an-hour, I got a shot at the bird, which turned out to be a male Mealy Redpoll (*Linota linaria*). Having obtained this bird close to Habarova, I do not hesitate to ascribe the linnets seen by ourselves and Mr. Jackson—"The Great Frozen Land," p. 34—on Waïgatch to the same species.

Returning to the launch, we saw there would be some difficulty in getting her out of the lagoon, for the tide had fallen and the waves were breaking angrily on the bar. And so it proved; the first two attempts were failures; on the third, the launch stuck right across the small channel. A strong current was running out of the lagoon, and, meeting the wind outside, threatened to roll her over every moment. Jumping out, I placed my gun in safety, and joined three of our crew in mid-stream; there we stood up to our waists, with our backs against the launch, while Kjeldsen and others tried to keep her upright with poles, the seas constantly breaking over us all. A lively ten minutes! Fortunately some of the Russians saw our trouble, and ran down with ropes; by their aid she was at last got back into the lagoon without damage. Kjeldsen and Larsen remained with her till next high tide, while we returned to the ship in a large flat-bottomed surf-boat rowed by some of the Samoyeds.

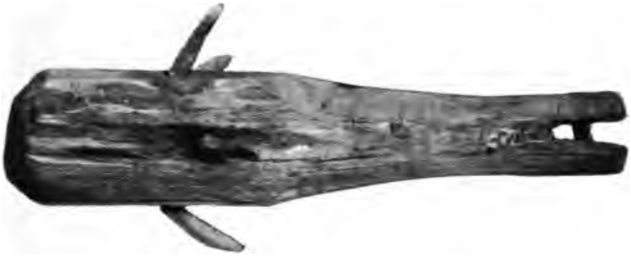
July 15.—The following day was spent in searching for a supply of water on Waïgatch, with poor result. We shot a male Red-throated Diver and two young in down on a lake, the female keeping out of range; and found several nests of the Little Stint, most of the eggs incubated. It was a lovely night; at midnight the sun was shining brightly, and the moon, nearly full, was high up in the heavens, clouds and sea showing the richest colours. The whole looked far too much like a weather-breeder however, an opinion confirmed next morning when we woke to find a wet fog and heavy wind from the south-east.

The fog was too thick to allow us to do any work on land, so the day was spent clearing-up on board.

July 17.—Hansen and I went to Waïgatch to-day, hunting the nests of Buffon's Skua, but failed utterly to find either nests or young, although we felt sure the birds were breeding.

Feilden and Curtis landed at Habarova, and found some Russians and Samoyeds fishing in the sea with a long seine net. Plate 43B shows two of them clearing the net after a cast. The first attempt brought seven good *Salmo omul* (largest about 3½ lbs.) and three *Salmo alpinus* to shore; and our party were presented with three of the best fish, in return for their assistance in drawing the net. The floats of the net are flat pieces of wood three or four inches across, and of a horse-shoe shape. They are constantly to be found among the rejectments of the sea on the shores of Kolguev, Novaya Zemlya, and Waïgatch. For sinkers, pieces of heavy bone are used, generally fragments of the skull of the walrus or the butt ends of reindeer horns.

After securing some photographs of the scene, they walked to a low ridge of hills, some six miles to the west of Habarova, rising 75 to 100 feet above the tundra. Many lakes and tarns were passed, by one of which they found two Red-throated Divers' eggs, both malformed. A deserted nest of the Long-tailed Duck contained six eggs; the remains of the old bird lay a few yards off, showing no indication of how she had met her end. Two Turnstones were seen on the shore. We were surprised not to find this bird on Waïgatch, as the country appeared so suitable for it, and we had met with it on Novaya Zemlya in 1895. A Merlin swept past out of shot; and a family of White Wagtails were busy catching flies in Habarova. Both these species have been recorded from here by Mr. H. L. Popham in 1895 (see "Ibis," 1897, p. 89), and they were also found on the Petchora in 1875 in lat. 68° by Messrs. Harvie Brown and Seebohm. Habarova has a short Arctic summer; still the number of flies about the place—probably due to its delightful sanitary state—constituted such a land



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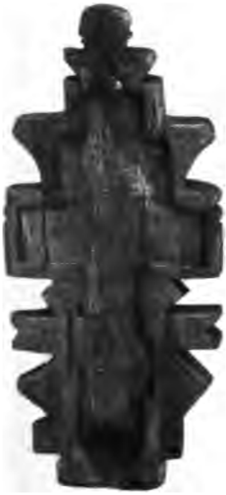

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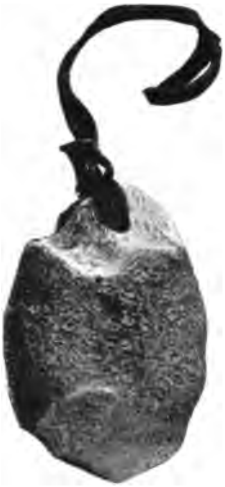

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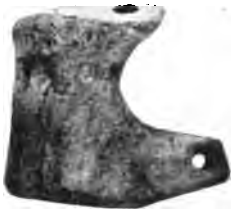


5

1. SAMOYED ANCHOR, FROM CAPE MATINSELA.
2. SAMOYED TALLY-STICK.
3. SAMOYED CROSS, FOUND NEAR A GRAVE AT BELOOTCHIA BAY.
4. FISHING-NET SINKER, MADE FROM WALRUS' SKULL.
5. ,, ,, ,, MADE FROM REINDEER'S ANTLER.

of plenty for Wagtails, there was little wonder the first wanderers and their descendants should continue to return to it each summer. None of us saw any trace of Willow Grouse or other species of *Lagopus* about Habarova, on Waïgatch, or Novaya Zemlya. The excrement of this bird resists the action of the weather a long time, so that we could scarcely fail to observe it on some part of the large extent of country we covered. It is probable that Mr. Jackson is right in his presumption that the Karataika River forms their northern boundary in this part of the world. All records of their appearance beyond it rest on far too slender evidence.

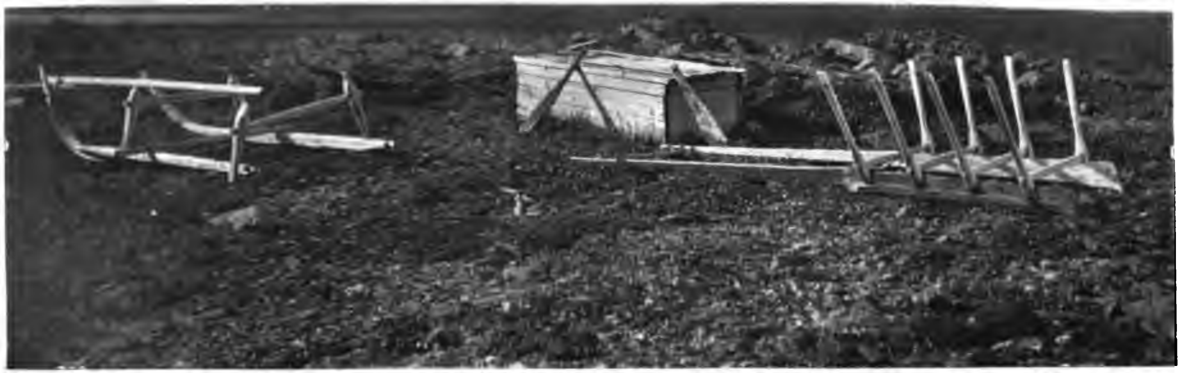
July 18.—As the wind was still unfavourable for an attempt to reach Khapidirsh Bay, I determined to make a short run to the eastward, and steamed through the Yugor (or Pett, for the English have a fair claim to name this passage) Strait into the Kara Sea.

We passed up the coast of Waïgatch to Cape Matinsela without seeing a fragment of ice; and anchored to the south of the point, a mile from shore, in eight fathoms. A large rock stood three or four feet above water in the centre of the south bay, and the north bay showed reefs in all directions; in fact, the whole coast was one on which Kjeldsen had no desire to linger. The sea bottom was rocky, and the anchor was slow to hold. Landing at 5 P.M., we walked across the point to the north side, and made for a ridge of rocks, standing some twenty feet above the surrounding tundra. A little to the east was an old camping-place of the Samoyeds, which had been much and recently used. The ground was covered with chips of wood and other debris, amongst which was the tally-stick figured on Plate 46. The Samoyed has a bunch of these tallies strung on his girdle, and tells off the reindeer by tens, counting the ten notches on each stick twice (to correspond with the two notches on the back), then passing the tally to the other side of the girdle. When five sticks have gone over, he has marked off one hundred reindeer with little chance of error; and the whole herd is thus accurately counted. In the bed of an old lake about fifty feet above high-water, Feilden found a very curious old wooden anchor represented on Plate 46. It measured 14½ inches in length by 3½ inches diameter at the larger and 2 inches at the smaller end. The teeth in the larger part project 2 inches, and are made of bone; they are let into morticed holes, and wedged in position by pieces of wood; at the other end is a slot with pin passing through it to fasten the line on. On our return to Habarova, Ivan told us it was an ancient Samoyed anchor, used for very small boats before iron was so common here.

On the highest point of the rocks named above we found the sequel to the destruction of the ancient sacrificial pile on Cape Greben by that too enthusiastic Pope in 1893, for here was an entirely modern pile made beyond the range of the Russians, who never visit Cape Matinsela, and containing no bones more than three or four years old (Plate 44). A bear's skull and several antlers of reindeer were the chief features, some of the latter yet retaining pieces of the velvet. Yet no Bolvan or god could be found here. Evidently the Samoyeds, while retaining much of their heathen forms of superstition and worship, have lost most of the essence, in exchange for a dim conception of the religion of the Greek Church.

Feilden, accompanied by Daniel, went to the southward, and during his walk he saw three pairs of Wheatears, a Dotterel's nest with three eggs (greener in ground colour than any taken previously), and a Little Stint's with four eggs nearly hatched. Hundreds of Long-tailed Ducks were on the sea. A pair of Glaucous Gulls had young partly feathered, on a detached pinnacle of rock, which Daniel fetched down to serve as food for the young Buzzards on board. A shot at the old Glaucous brought up two Peregrine Falcons with angry cries, and a short search revealed their nest. It was placed on a knife-back ridge of sand-cliff jutting out into the sea, and some fifty feet high. There was no difficulty in walking to it, although the ridge on which it lay was only a foot in width. The nest was made entirely of grass, and contained three young in white down, an addled egg lying close to it. These young showed only the slightest trace of the projection or tooth

PLATE 47.



F. 11. 1/5 s. 4.55 *p.m.* 20-7-97.

SAMOYED GRAVE, WITH SLEDGES AND BOAT-PADDLES.

DOLGOI ISLAND.

on the upper beak, so marked in the old bird; and from a study of a large series in the British Museum, I conclude this projection develops when the bird learns to tear its own food to pieces; for it is large enough to be of service in birds retaining slight traces of down among the feathers.

Curtis and I continued up the coast to the north. Five Ducks without wing-feathers were on a long narrow lagoon, separated from the sea by a high shingle bar; we shot one, and found it to be a Goosander. Very pleased we were to establish the fact, for although we had seen Ducks in 1895, and on several occasions this year, that we felt certain were too large for Red-breasted Mergansers, this was the first time we had shot one. There seems to be no previous record of this bird in Waïgatch or Novaya Zemlya.

The next ravine contained the largest collection of driftwood I had seen in the Arctic. All the wood was very old and decayed, but enough remained *in situ* to show what fine trees many of them had been. I measured several 35 to 40 feet in length and over a foot in diameter. The original diameter could not be determined, for the sappy part of the tree had decayed first. This mass of driftwood extended quite 300 yards up the valley, above the highest recent tide-marks; and that at the top must have been 35 feet above present sea-level, telling of a considerable elevation of the land since it floated in from the sea. From what I have observed of wood in the Arctic, I have little hesitation in saying that none of it had been there less than three hundred years, and some probably much longer. Unfortunately the light was not good, and the photograph in Plate 45 gives a poor idea of the scene. This photograph was taken near the centre of the ravine, looking towards the sea, and therefore only shows the lower half of the driftwood accumulated here.

We had been making for some bluffs seen on the horizon from the Samoyed pile, expecting to find rocks suitable for hawks or birds loving such positions. They proved to be about 2½ miles up the coast, and although they disappointed us respecting the birds, they were most interesting geologically, as we found them to be hills of sand and mud (chiefly sand) without any sign of stratification, containing erratics in about the same proportion as the cliffs of Kolguev, and very unevenly distributed. Setting the aneroid at the sea-level, it showed the height of the bluffs to be 115 feet. The rock *in situ* only rose two feet above sea-level, and looked a hard black slate with perpendicular cleavage (Plate 88).

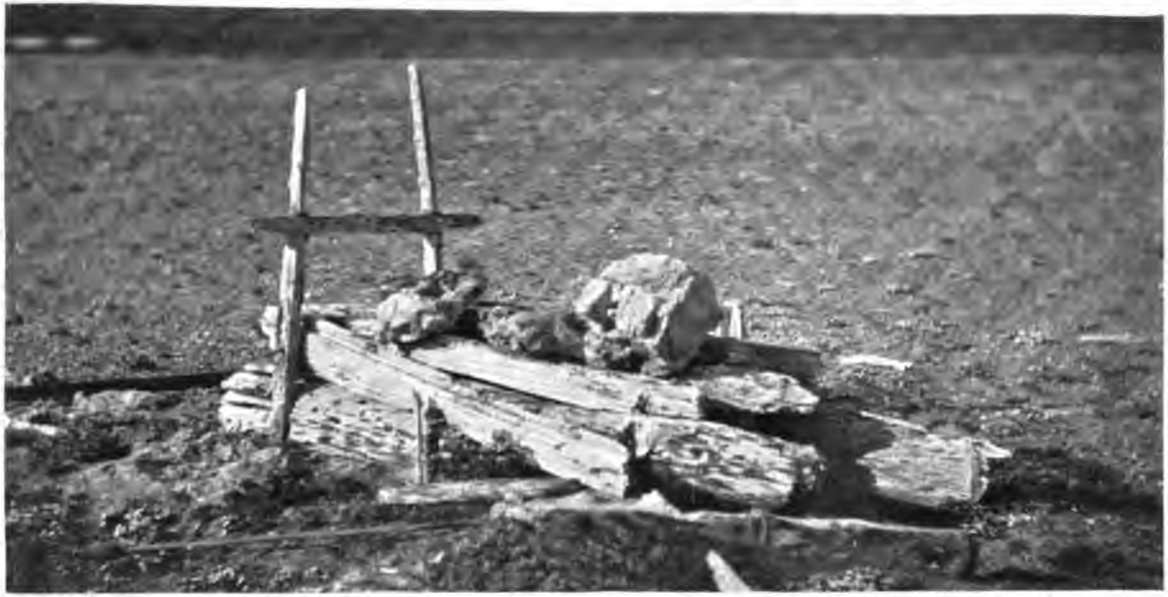
From the bluffs we walked on to the Fahishiba River, a small stream running through a rocky fissure, and reminding me of the moorland rivers in north-west Yorkshire; it was the first of the kind we had seen on Waïgatch. We now turned back for the ship, making a long detour inland. Birds had been scarce on the coast, but became more numerous as we left it. Little Stints were constantly seen; there must be thousands of them on this island; wherever we land they are plentiful. Many Shore-Larks were about, also Snow-Buntings; and both Purple Sandpipers and Red-throated Pipits were fairly common. A solitary Snowy Owl kept carefully out of shot; and all our efforts to find either eggs or young of this bird have failed, doubtless owing to the fact that Lemmings are so scarce this year. During our stay only one Lemming has been seen, captured after a smart chase.

The following is a list of the birds seen about Cape Matinsela:—

Wheatear, three pairs seen.
Red-throated Pipit, common.
Shore-Lark, common.
Snow-Bunting, common.
Snowy Owl.
Peregrine Falcon.
"Grey" Goose.
Long-tailed Duck, very common.
Goosander, first record.
Ringed Plover, fairly common.
Dotterel, several pairs.
Purple Sandpiper, several pairs.
Red-necked Phalarope, several pairs.
Little Stint, common.
Glaucous Gull, several seen.
Diver (?).

From the highest hill both the men and I thought we saw ice some twenty miles off to the east, but there was not a piece any nearer. We met Feilden on the beach at midnight. All had thoroughly enjoyed their seven hours here, enhanced by the delightful

Plate 48



F. 11. 1/5 *S.* 4.40 *p.m.* 20-7-97.

CHILD'S GRAVE ON DOLGOI ISLAND.

weather and the absence of mosquitoes. Kjeldsen had the anchor up directly we were on board; he was most anxious to leave. He has coined a new word, "Anchoration," and very expressive it is as he uses it; for he makes it convey more than "anchorage." We have certainly seen no place on this east coast of Waïgatch to which it can be applied. After some supper we were busy till 4 A.M. clearing up the work of the day.

July 19.—We woke to find the ship at anchor off Habarova. Young Alexandrovitch and some of the Russians came on board to say farewell; and the glass being steady, with light favourable wind, we started at noon for the Karataikha River, keeping some six to eight miles from the coast, at which distance the lead at first showed twelve to eight fathoms. As we proceeded the water continued to shallow, and forced us farther from the coast, until at 11.30 P.M. the man with the lead called out five fathoms. We were now three points south of west from Bylkovsky Nos, and ten miles distant; twenty miles from the mouth of the Karataikha River, fifteen miles from Selenitz Island, and forty miles from the head of Khapidirsk Bay. My English chart showed six fathoms at the entrance of the bay quite sixteen miles beyond our present position, and it was on this figure I had argued the possibility of reaching the rivers or coast in a launch. In considering what was to be done under these unpleasant circumstances, we were obliged to bear in mind we had no certain knowledge the launch could enter the Karataikha River, the nearest point available for our purpose. The Russians thought it possible, but evidently knew very little about the depth of water. Until one knows these countries by personal experience, it appears absurd to doubt that a boat drawing three feet can enter a river whose channel is a mile wide, and its stream at the lowest period of the year three hundred yards across and twenty feet deep; but from what we had seen elsewhere we could well understand the bar at the mouth might prove both impassable and unapproachable. Should this be the case, eight hours must elapse before we could regain the ship, and much might happen in that time. If the *Laura* had been in a safe anchorage, we could have relied upon her waiting for us; but in this open bay, with only five fathoms of water, she must have left for the north on the first appearance of a change in the weather, as Habarova—thirty-eight miles away—was the nearest shelter. To leave the ship under these circumstances would have been not only rash, but utter folly.

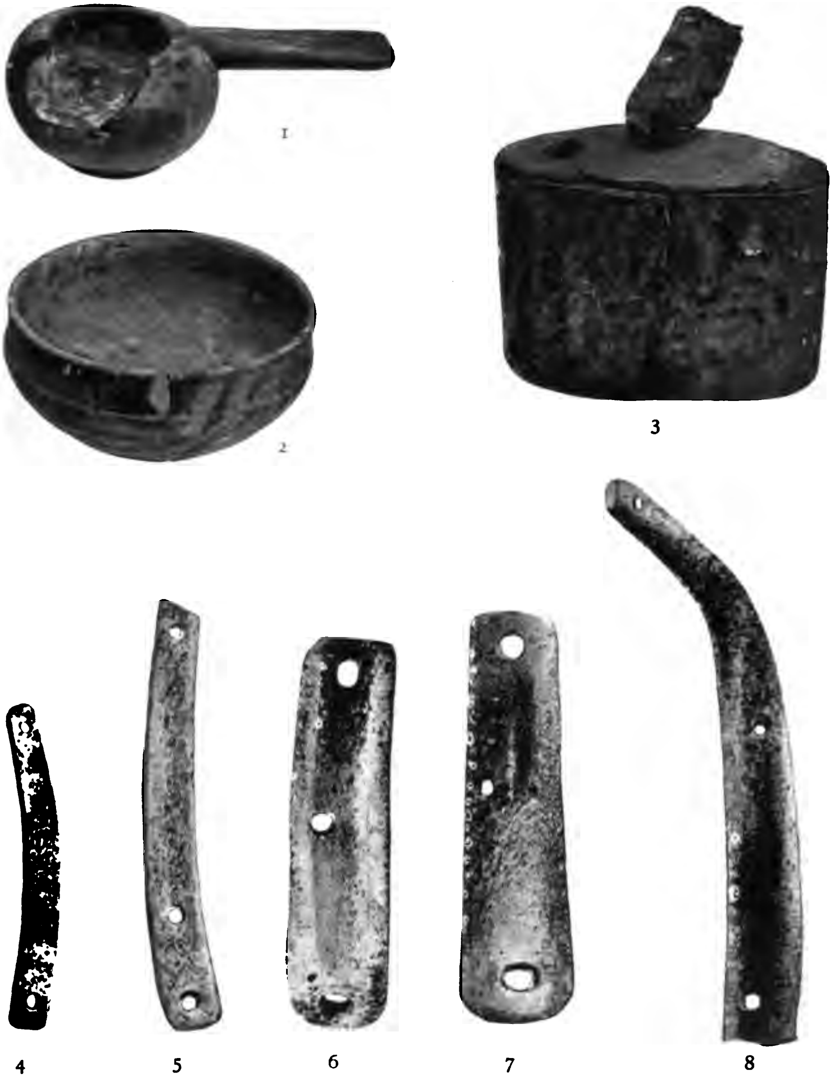
Thus in ten minutes I was obliged to give up the chief object of the expedition, as impracticable from the sea, a grievous disappointment.

The soundings to-day have all been much shallower than those marked on the charts; where the latter showed twelve fathoms the lead gave eight. It has occurred to me that the printed soundings were those made by Lütke during his survey in 1824; still it scarcely seems possible such a vast amount of deposit could have been made during so short a period.

July 20.—We anchored this morning at 8 A.M. off the centre of the east side of Dolgoi Island or Dolgoi Ostrov, one mile from the shore, in seven fathoms, and a hard bottom. The island runs from south-east to north-west, and is some 17 miles long by 1½ to 2 miles wide. It is the largest of a group of five which lie off Cape Medenski Savarot, and stretch into the sea in a NNW. direction. These islets were well known to the navigators of the sixteenth century, and are mentioned several times in the first and second voyages of Barents. Admiral Lütke gives some little information about them, but I cannot find that they have been visited by our countrymen during recent years, nor am I aware of any published information in regard to their geological structure or natural history. The absence of any anchorage, and the fact of the ice lingering round them most of the summer in ordinary years, will account for all modern voyagers giving them a wide berth.

Favoured by a lovely day and calm sea, we landed from the launch, and quickly learnt we had arrived at a little paradise for birds. Snow-Buntings were as numerous as on Waïgatch; Lapland Buntings scarcer (only twenty or thirty seen); Shore-Larks and Red-

PLATE 49.



RELICS FROM SAMOYED'S GRAVE ON DOLGOI ISLAND.

1-2. WOODEN BOWLS.

3. SNUFF BOX, WITH COPPER SIDES AND WOODEN ENDS.

4-8. PARTS OF REINDEER-HARNESS, MADE OF BONE AND HORN.

throated Pipits were everywhere accompanied by their young; sixteen to twenty pairs of Grey Plover seemed to have completed their domestic duties for the year, as the young were on the wing; they and the parents were very wild. We took several nests of the Little Stint, all the eggs much alike in tone of colour, and incubated. Dunlins were thinly distributed, one or two being seen in most marshes. Ivan's statement respecting the Eider proved correct, as only the King-Eider was seen here; a young in down was fortunately secured, with its mother. So little had the birds here learnt to regard man as a dangerous animal, that when a duck was shot, some Richardson's Skuas swooped down and battled for the prey. They were the only species of Skua seen on the island. Both Black and Red-throated Divers were in far greater numbers than we had ever seen them before; the latter species being much the more numerous. The island was well adapted for their breeding requirements, as that part we walked over was thickly studded with lakes of all sizes, from 700 yards across to little tarns. Most of the Divers had young, which concealed themselves effectually among the long grasses; we saw several old birds carrying fish in their beaks from the sea. Two Black-throated Divers were identified on a mere with their young; the latter scrambled on to the back of one of the parents, and then both old birds swam into the middle of the lake. Plate 51 shows a Red-throated Diver's nest on the peaty margin of a tarn here.

Apparently the strongest winds on the island are from the west. I noticed the banks of peat, forming the shores of the larger lakes, were being broken up on that side and re-deposited on the east side in beds several yards wide, on which grew luxuriant crops of coarse grass.

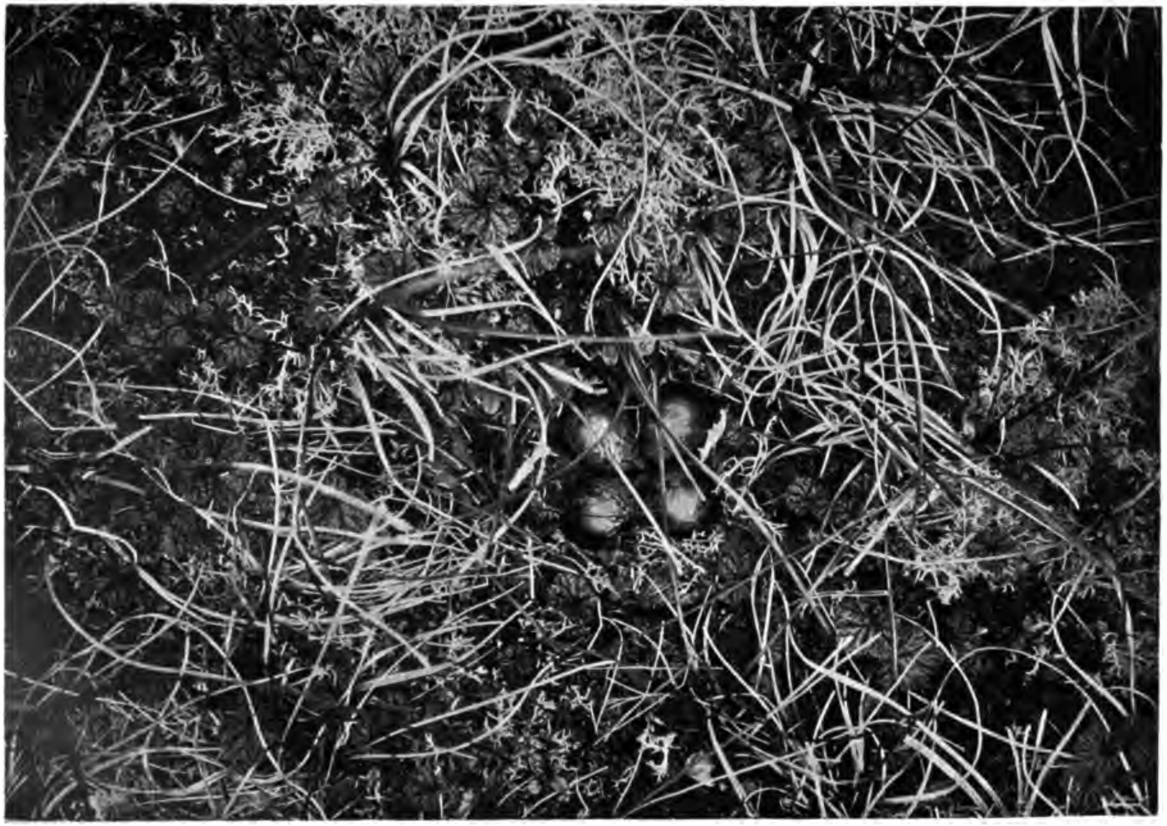
Flowers were plentiful in parts, but afforded no beautiful masses of colour, like those near Cape Greben. Our botanist gathered over seventy species of flowering plants, all common to this island and the adjacent mainland of Arctic Russia.

We saw no living human being, although we were told at

Habarova that Samoyeds visit the island from the mainland during the early summer to collect eggs. Feilden, however, discovered the graves shown in Plates 47 and 48. Seeing the remains of some sledges lying about a hundred yards from the sea on the west coast, he went to the spot, and found it was a Samoyed burying-place. Two old weather-beaten trunks lay under the shelter of a rock, close to the broken sledges. The length of the one was 5 feet, width 23 inches, depth 13 inches; the other 5 feet 6 inches long, 24 inches wide, 14 inches deep. The older one was made of rough boards put together with nails and some wooden pegs; the other entirely with nails. Lifting the stones from the top of the first, the loose crumbling plank came off easily, showing the remains of the dead. The body had been buried in all its clothing and pesk of reindeer skin. The black lank hair still adhered to the skull. Some bits of broken iron pot, wooden bowls, and fragments of household gear lay on the right side of the skeleton. The second seemed to be a newer burial. The body was likewise dressed and enveloped in its mantle of reindeer skin with hair on; a rude snuff-box, broken wooden bowl, and a few other articles lay on the right side of the body. Alongside the coffin or trunk were two boat-paddles. The three sledges were broken; the bone driving gear for the harness lay scattered around, the reindeer-traces having long since disappeared. About a hundred yards from these two trunks, and in a north direction, was a child's grave (see Plate 48). The little occupant had mouldered away, like the reindeer clothing in which it was packed. The skull had separated at the sutures, the second teeth were showing in the lower ramus—probably a child about five years old. At the child's feet was a Snow-Bunting's nest containing five eggs, and on the remains of the skeleton lay the dead parent with extended wings; doubtless the bird had entered the tomb in fine weather, and a sudden snowfall had trapped it. No Bolvan or sacrificial pile was seen here or on the island.

Kjeldsen and two men had walked towards the north and shot a

PLATE 50.



F 64. 15 *S.* 10.45 *p.m.* · 20-7-97.

LITTLE STINT'S NEST, *Tringa minuta.*

DOLGOI ISLAND.

number of birds, but only the same species we had seen. A complete list of the birds seen here will be found in Appendix G.

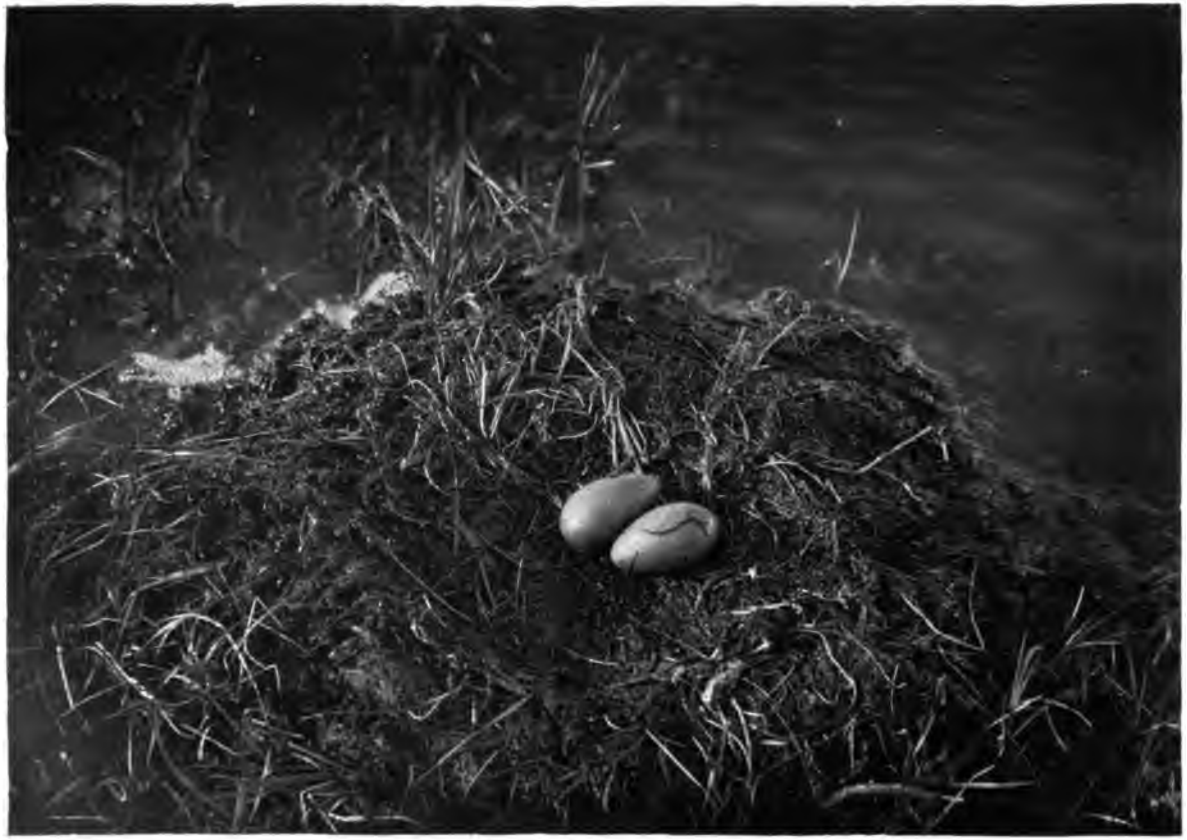
The launch had been moved three miles down the coast, and the party met there at 7 P.M. At that time the evening was still beautifully clear, with scarcely a breath of wind; but a long rolling swell was already breaking on the rocks—sure forerunner of wind to come—and made it difficult to get off. By the time we reached the ship, a strong northerly wind was blowing; and before we had got out of sight of Dolgoi Island the seas were breaking more than two fathoms deep a mile from the northern shore; a useful object-lesson of what might have been the fate of the ship had she waited for us off the Karataikha River.

CHAPTER VIII

NOVAYA ZEMLYA AND LÜTKE LAND

JULY 21.—It now being clear that it was impossible to land on any part of the country for the investigation of which this voyage was undertaken, we decided to spend the remainder of our time on the islands of Novaya Zemlya, and set our course up the west coast of Waïgatch for Kostïn Shar. The 21st was a fine day, with no ice in any direction, and slight wind, but that dead ahead of course. It always was on this voyage.

July 22.—The next morning was beautiful, except for a heavy fog-bank over the sea, which threatened to envelop us most of the day as we steamed up the south coast of Novaya Zemlya and Meshdoshapsk Island. On the latter we saw with our glasses a large wooden house and flag-staff not observed in 1895. This land is indeed becoming far too much inhabited for either sport or ornithology as concerns the larger birds. In the evening, Curtis, Kjeldsen and I landed near the north-west point of Meshdoshapsk Island, rowing first to a detached rock shown in Plate 53. All its upper ledges and the top were absolutely packed with Brünnich's Guillemots, except a small space in the centre, where six young Glaucous Gulls held sway. There was a much larger colony of Guillemots on the rocky coast of the main island, also many Kittiwakes and their young (fully fledged, but down showing through the feathers). Most of the Guillemots had young, a few eggs being either incubated or addled. Three Snowy Owls were near the coast, no doubt in attendance on the young Guillemots, like the Glaucous Gulls. The track of an ice-bear was deeply marked along the edge of the cliffs; he had been hunting there some weeks before, when the ground was soft after the spring thaw.



F. 64. 40 *S.* 6.30 *p.m.* 20-7-97.

RED-THROATED DIVER'S NEST, *Colymbus septentrionalis.*

DOLGOI ISLAND.

Returning on board, we steamed up to Belootchia Bay, and anchored there at 1 A.M.

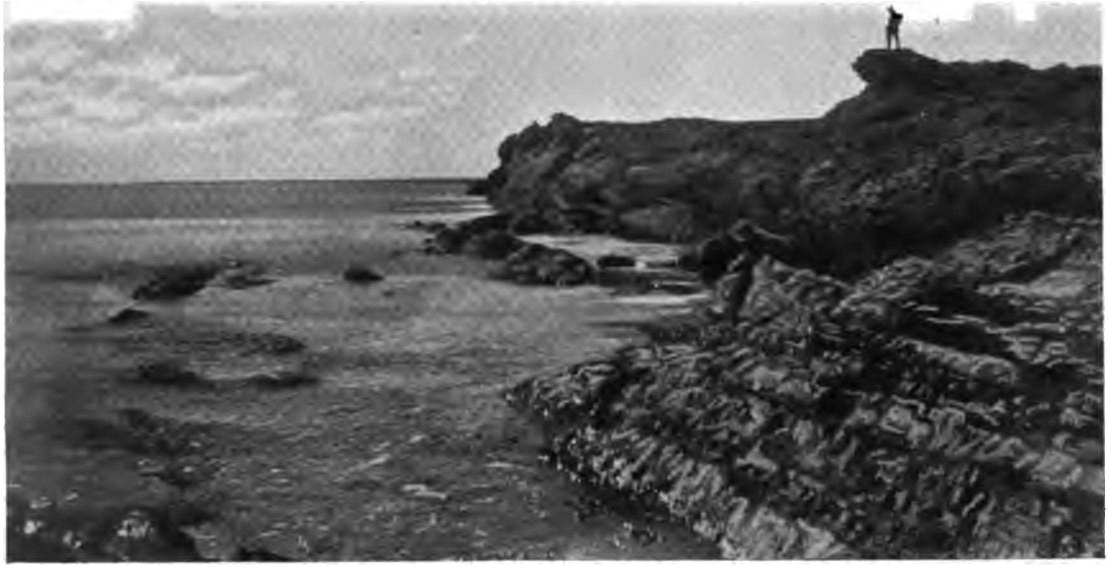
July 23.—Feilden and I landed after breakfast to visit our friends of 1895, but only Taitiana was there of those we had seen before. She remembered us at once, and seemed much pleased to receive some of the photographs of her family and home taken in 1895.

The Russian trader had called five days before, and bought all the skins procured during the winter, namely, seven Ice-Bears, three of them very large, and 108 Reindeer. Taitiana told us the house we had seen on Meshdoshapsk Island had recently been built by another Samoyed. In answer to my inquiry if her husband could take me to any nests of the Snowy Owl, she said they generally laid their eggs in May, and this year there had been very few; I understood only one nest had been found, and that on Meshdoshapsk Island. On showing her some young of the Little Stint, caught a few hundred yards from her hut, she explained the dogs usually ate all those small fry before they could fly. These brutes are indeed a devouring pestilence. Fancy forty to sixty half-starved dogs ranging at will over the country, eating everything they can catch, from Little Stints upwards; small chance of finding anything after them! The Samoyeds were living in the hut this summer, the choom being probably taken on the hunting expedition. They must kill an immense number of geese, judging from the bodies and legs hanging up to dry in the wind. In the skin-house was another heap of bodies, decidedly putrid. Here also hung some long strings of the upper mandibles of Bean and White-fronted Geese, made as playthings for the children. Human nature is the same everywhere; one child had a doll, the dirtiest little rag of abomination, which she presented to Feilden with a smile, in return for some chocolate.

As Feilden and Curtis wished to devote a few hours to our increasing collections, I took the launch up the bay, along with Kjeldsen and three men, to the inlet visited in 1895. The fog had now cleared off, leaving the sky heavily clouded and the light bad. We saw fifteen or twenty moulting Geese near the head of the bay, but they made off into water too shallow for the boat. Our disappointment was forgotten as soon as we passed the bar, for there was another flock, all Bean Geese, and we soon had nine of them. On rounding the next point, a larger flock was seen ahead, to which we at once gave chase. They were swimming in very close order, but did not appear to realise our speed or how serious things were, until we had almost steamed within range. At forty yards I got both barrels in and Kjeldsen one, with the result that seven geese waited for us to come up, while several others were wounded. Leaving Daniel in the skiff to collect them, we steamed round to head off the others, who had scattered in all directions, and made wonderful pace through the water. In ten minutes sixteen White-fronted Geese had come on board. It sounds like slaughter, but our crew had now been living on salt meat for a month, and we in the cabin had tasted no fresh meat for nearly the same length of time; so those geese were welcomed with a joy that people who have lived within reach of a butcher's shop all their lives can hardly realise. Very good eating the younger birds were too; especially when cooked with a couple of large slices of smoked bacon on the breast. We stuffed them with bread crumbs and onions, and did without the apple-sauce, for there are many things you can dispense with when you can't get them.

We continued up the estuary until the boat stuck fast, and all efforts to find a deeper channel failed. A screw launch drawing three feet is little use for this exploring work; it should be a big, broad, but shallow boat, with rear-paddle which will work in 18 or 21 inches; the engine and boiler must also be so arranged that they can be easily removed; then the boat can be got on deck or hung in the davits of a ship suitable for such an expedition.

Landing here with Hansen and Daniel on the east bank, I walked up-stream, stopping to take photographs of the vertical strata on the lower banks, and also of some peculiar crumpled strata. Passing the highest point reached in our walk on July 24, 1895—a place evi-



F. 11. 1/25 *S.* 5.15 *p.m.* 20-7-97.

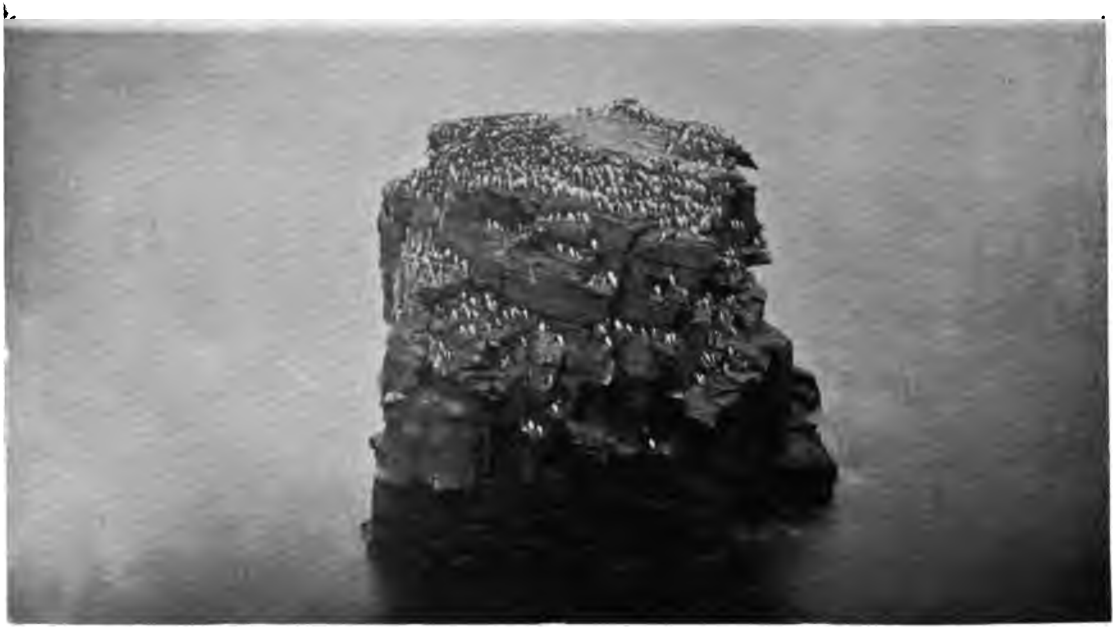
WEST COAST OF DOLGOI ISLAND.

dently often used as a camping-ground by the Samoyeds—I struck away from the river to higher ground, from which could be obtained good views of the ranges of hills to the east. They appeared some seven miles distant, and about 800 feet high, their southern end coming down to the head of Rogatchiva Bay, and the range generally running from south-east to north-west. In sailing towards this south part of Novaya Zemlya the hills above Rogatchiva Bay form a good mark to steer for, taking care to keep well in the centre of the channel between Podvezoff and Meshdoshapsk Islands, and thus avoiding the reefs to the south-east of Podvezoff Island, named at p. 54, where we nearly came to grief in 1895. The country between us and the hills was of a rolling tundra character, with many lakes in its hollows, and covered with more moss and stones than grass. As it approached the hills it seemed to assume the "stone bog" character we had seen much of around Lake Nechwatowa. Through my glasses I could see several large masses of snow on the hills, but nothing like a glacier.

I then turned towards the higher reaches of the river, and was surprised to find its character entirely altered. Instead of a stream a hundred yards wide, it was a succession of long shallow pools, intersected by rapids flowing over shingle banks with falls of three to four feet. There were traces, however, of spring floods reaching nearly to the tops of the banks. I was very glad to investigate this river again, for in 1895 we formed the opinion it was a broad river running many miles into the interior of Goose Land; whereas now we know we were deceived by the tide holding up the fresh water, and that the stream is only a magnified shallow brook, like all these Novaya Zemlya rivers in summer.

From the speed of the launch and the time occupied in walking, I calculated the distance to be six miles from the Samoyed hut to bar at head of bay, four miles from bar to highest point reached by launch, and four and a half miles from launch to highest point I walked to. On the way back we saw a very large party of Geese, quite forty to fifty, and after considerable trouble some of these were added to our food-supply. We shot in all nine Bean Geese and twenty-seven White-fronted Geese. Of the nine Bean Geese, the longest measured 31 inches from tip of beak to end of tail, and the shortest 27 inches; of the White-fronted Geese, the largest was 28 and shortest 25 inches. We regained the ship just before midnight.

During our absence, those on board had received a visit from some more of the inhabitants. A boat came alongside containing two Russians, a Russian woman, and three Samoyeds, with whom a brisk conversation was carried on through Pettersen. The elder Russian, dressed in long blue coat and a civilised cap, said that he had a home and settlement on the opposite side of the bay. He had wintered three times in Novaya Zemlya, but on his return last autumn to the Petchora he had married, and brought his wife back this spring—a not bad-looking, blue-eyed Russian peasant girl, dressed in a pink calico tea-gown of gorgeous pattern, thrown over her Samoyed fur kit. This lady was so overcome by the presence of our crew gazing at her from the bulwarks, that she knelt down in the boat, buried herself in a pile of skins, and groaned! A plate of figs was brought from the cabin; and when her husband told her we were good Christian men, she got up from her recumbent position, scrambled up the accommodation ladder, and leant over the bulwarks to receive the dried fruit. One of the Samoyeds, an intelligent fellow, had on a swell pair of Russian boots, took snuff with the air of a beau, and evidently thought himself a young prince. He lives in the new house on Meshdoshapsk Island that we passed yesterday; and saw our ship steaming up the coast. The other Russian took little or no part in the conversation, but all of them showed great interest in the Russian charts of Novaya Zemlya, and asked if they could get them, also the cost. The youngest of the Samoyeds was the best-looking of the race we had seen; he had a delicate, straight nose, fine mouth, and a refined look very different to his Russian companions. He corrected our false pronunciation of the names on the Russian charts with great glee.



F 11. 6 *S.* 7.45 *p.m* 22-7-97.

BIRD-ROCK OFF MESHDOSHAPSK ISLAND.

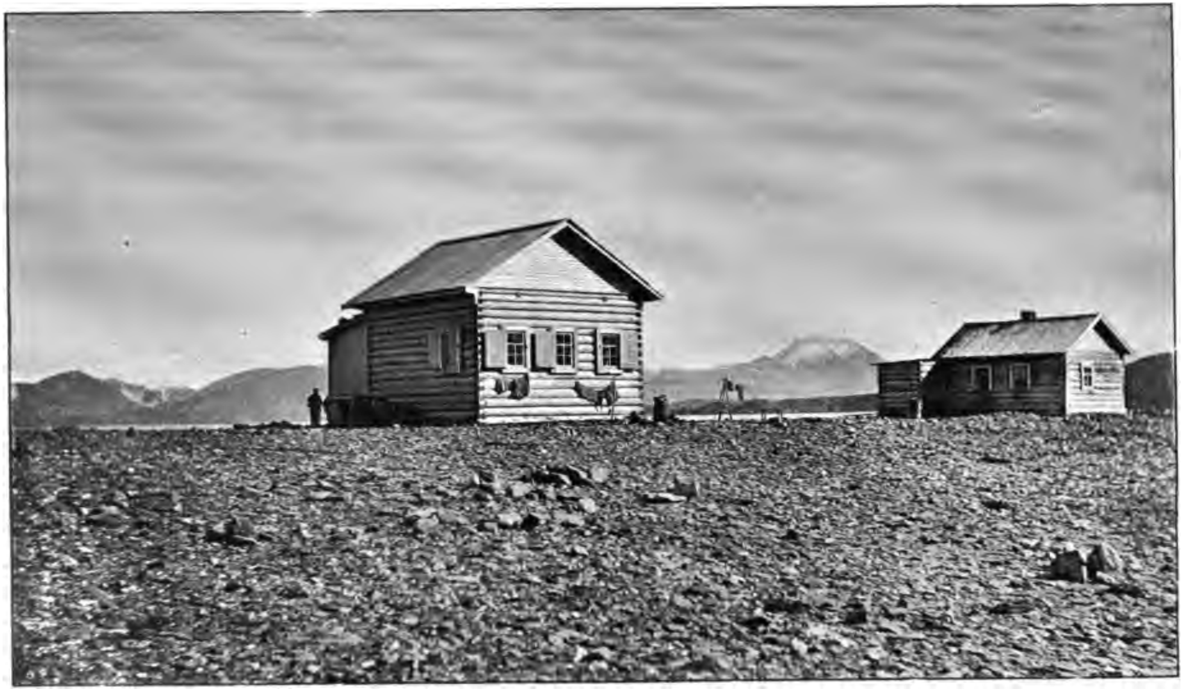
NOVAYA ZEMLYA.

These Russians and Samoyeds seemed to be on terms of complete equality.

July 24.—Heaving the anchor the next morning, we steamed down Belootchia Bay, rounded Podvezoff Island—giving it plenty of sea-room this time—and, shutting off steam, sailed before a fair breeze for the first time since we left Bergen on June 4th, a tolerably long record of head winds. But the Fates only spared us and Herr Giæver's coal for three hours, as the wind then worked round to the north and soon increased to a summer gale, which continued through a greater part of the 25th, and re-arranged all the loose furniture in the cabins in a manner not at all conducing to our comfort. That day we saw Fulmars for the first time during the voyage.

July 26.—The 26th brought quieter sea and less wind, enabling us to make better progress. About 1.30 P.M. we were off Nameless Bay, and passed through continuous flocks of Brünnich's Guillemots coming from the great loomeries there. Proceeding up the coast, we reached the entrance of the Matyushin Shar, which is well marked by a double-topped hill on its south side named Cape Columns. To enter Matyushin Shar from the south, steer well into the island at entrance of Silver Bay until you get about the middle of the Strait, when you have the points of Cape Columns and Pomorsky Bay (Cairn Harbour in Admiral Markham's "A Polar Reconnaisance") in line, then steer straight for some bold rocks standing out of the water off Cape Columns, and pass then at not less than a quarter of a mile on the starboard side. The first bay to the south is very shallow; the second is Pomorsky Bay, and that also proved of considerably less depth than the charts led us to expect, for we were only able to find four fathoms just inside its two headlands. Imagine our pleasant surprise when the bay opened out, at seeing three houses on the bar at its head, and this in a place we had hoped, from Admiral Markham's and other descriptions, to be a happy undisturbed hunting-ground! As soon as the anchor was down a party came on board, consisting of the head-man, a very intelligent fellow, dressed in a

Russian greatcoat and trousers, and several others in the ordinary Samoyed costume. After a chat, during which we learnt the Russian trading steamer had been here a few days before, to whom they sold thirty-nine Ice-Bear and about a hundred Reindeer skins, we went on shore to see the houses. We were welcomed by the usual howling tribe of dogs; some of them soon became very friendly, others quite the reverse, the latter being promptly fastened up by the women, with plentiful applications of a long pole to teach better manners. The principal house, shown in Plate 54, was far the best we have seen since leaving Norway. It measured 21 feet by 21 feet outside, and the porch, which extended the whole width of the house, was 7 feet wide. The walls, 13 feet to the eaves, were made of trees a foot or more in diameter, neatly dressed with an axe and well fitted; between each trunk was a layer of moss to make the joint air-tight. The whole had been put together in Russia and carefully numbered for re-erection. Five windows of good size had double glass and casements to keep out the cold. Inside the walls were nicely boarded with machine-planed wood, and were decorated with coloured prints and photographs, also a large Ikon. In one corner of the room was a well-built Russian stove; opposite it a large inclined bench, where most of the family slept, although some evidently reposed on the top of the stove. A bench ran round the remainder of the room, and near it were two tables. The whole was scrupulously clean, differing greatly from all we had seen before, and more like the better class of Russian houses. Our hostess placed on the table, and invited us to partake of, some dark but wholesome-looking brown bread and *Salmo alpinus* cut into squares; but as the latter was fresh from the sea, without the benefit of cooking, we declined, pleading the excuse we had just dined. No such qualms affected Kjeldsen and Pettersen, who made a hearty meal and declared it very good. I afterwards secured a photograph of the group against the side of the house, Plate 55. The head-man has a fur cap on and stands third from the right, his wife second from the left. She and the woman next her



F. 11. 1/5 *S.* 11.40 *a.m.* 10-8-97.

SAMOYEDS' HOUSES AT POMORSKY BAY.

were ill and called Curtis in for medical advice. As their symptoms were translated from Samoyed to Russian and then into English, he found it difficult to obtain all the facts of the cases, but formed the conclusion that they were suffering from phthisis. He said a kind word, provided some harmless medicine, not daring to prescribe anything of which double doses might cause trouble, and produced such a good impression that he received the *Salmo alpinus* held by the man in the picture as a fee. It is to be hoped that the Royal College of Surgeons will deal leniently with such a glaring case of taking fees without a degree. We helped to eat his ill-gotten gains next morning at breakfast and found them delicious.

The man and his family had spent the last three winters at Matyushin Shar in this house. He said the winters were certainly long and cold, but very pleasant, especially the hunting and shooting in the moonlight. He was a native of the Petchora Valley, but had lived nine years in Novaya Zemlya, and had received a decoration from the Tzar for some service we failed to understand. The ice had opened in the straits this year in May, much the earliest date he had ever heard of. In reply to a question respecting the value of the skins, he said the Russians allowed him fifty-three roubles for each bearskin last year, but the price for this year had not yet been arranged.

There are at present three settlements of Samoyeds in the south, one or more in Möller Bay, and this in Matyushin Shar. Part of the men here were about to leave for the north to establish another station at Admiralty Peninsula, on the west coast of Lütke Land, where they intended to winter. Each of these settlements must kill from a hundred to a hundred and fifty reindeer during the year, judging from the number of skins they sold and used for clothes, &c. I feel convinced this destruction is considerably in excess of the natural increase, so that reindeer must soon cease to exist in this country. The future opportunities for sport in Novaya Zemlya need little further explanation.

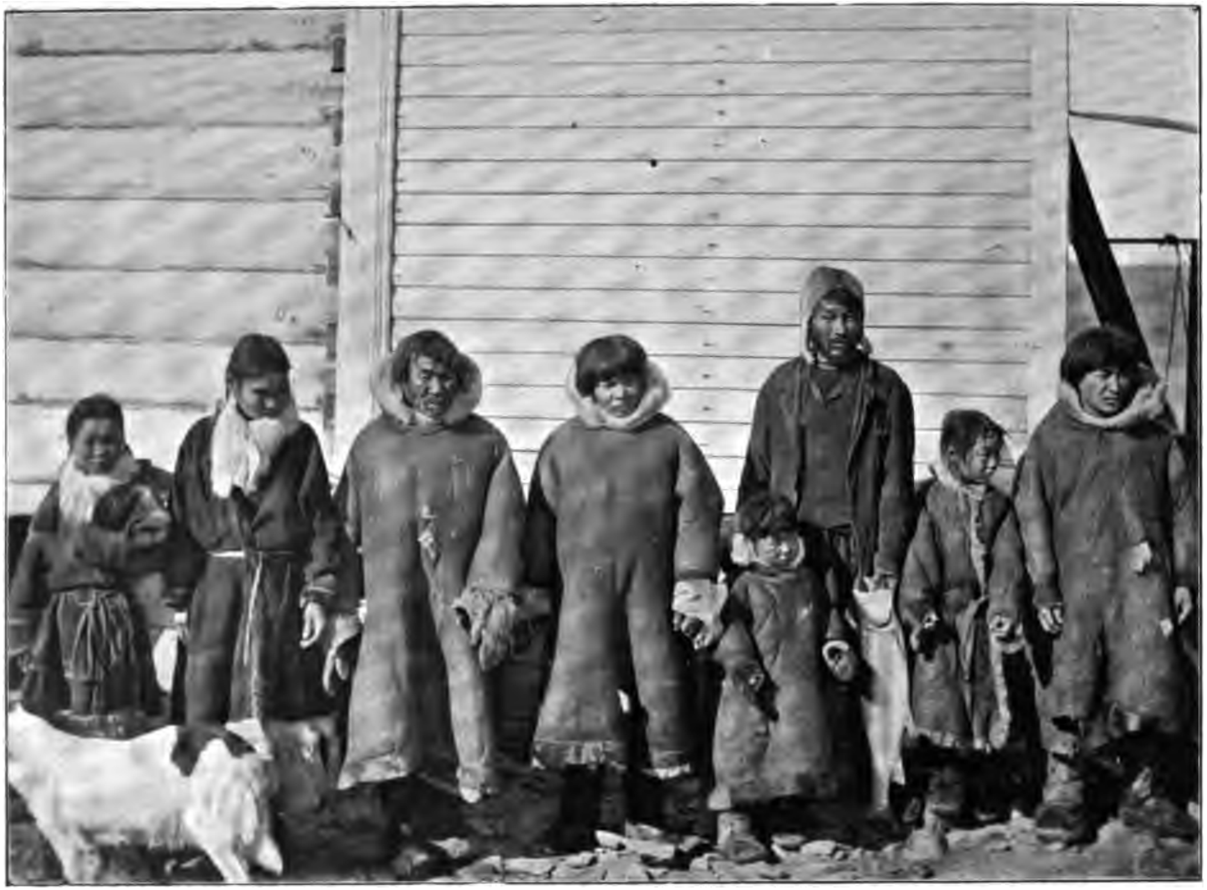
The surroundings of these houses were quite as filthy as those in Belootchia Bay, far beyond description; yet Kjeldsen wanted to take in water from the river!

Returning on board at midnight, we had a long talk with Kjeldsen over our future plans, and decided to pass through the Shar to Belushja Bay near its east entrance, where we hoped to find clear water and a country less disturbed.

July 27.—Quitting Pomorsky Bay the next morning, we steamed to the east through the straits. Unfortunately the tops of the mountains were shrouded in fog. Still the scenery was very fine, the mist often increasing the picturesqueness of the views. At 5 P.M. we entered Belushja Bay, and found a very snug anchorage in Seal Bay, a small indent on its east side, where Von Heuglin anchored in August 1871. Care is required in entering Seal Bay, as a large shingle bank projects on the west side, and another, farther up, from the east. We anchored behind the second in 3½ fathoms. A good stream of water comes in at the head of the bay from some lakes above. Soon after our arrival a party of Samoyeds, whom we had passed in the straits, came into the bay and camped on the shingle bank below us. They had three sailing boats, two coracles, and about fifty dogs. Of course some of the men were soon aboard the ship to learn who we were, where we were going, and what we came for. They seemed decent fellows, but very dirty as usual, and were on an expedition down the east coast of Novaya Zemlya.

July 28.—Leaving the ship at noon the next day, we steamed in the launch up the west side of Belushja Bay, thus avoiding a heavy north-west wind. Von Heuglin's description of the gales in this place was fully borne out by our experience, for it is the windiest spot I ever knew. The scenery as we passed up the bay was very fine, although wild and rugged in the extreme. Freddy Straits, between Belushja Bay and Meta Bay, are made too narrow on the American chart, for there is really little difference between the straits and the upper bay. This chart also gives too slight an idea of the extent of mud

PLATE 55.



F. 11. 1/2 *S.* 11.30 *a.m.* 10-8-97.

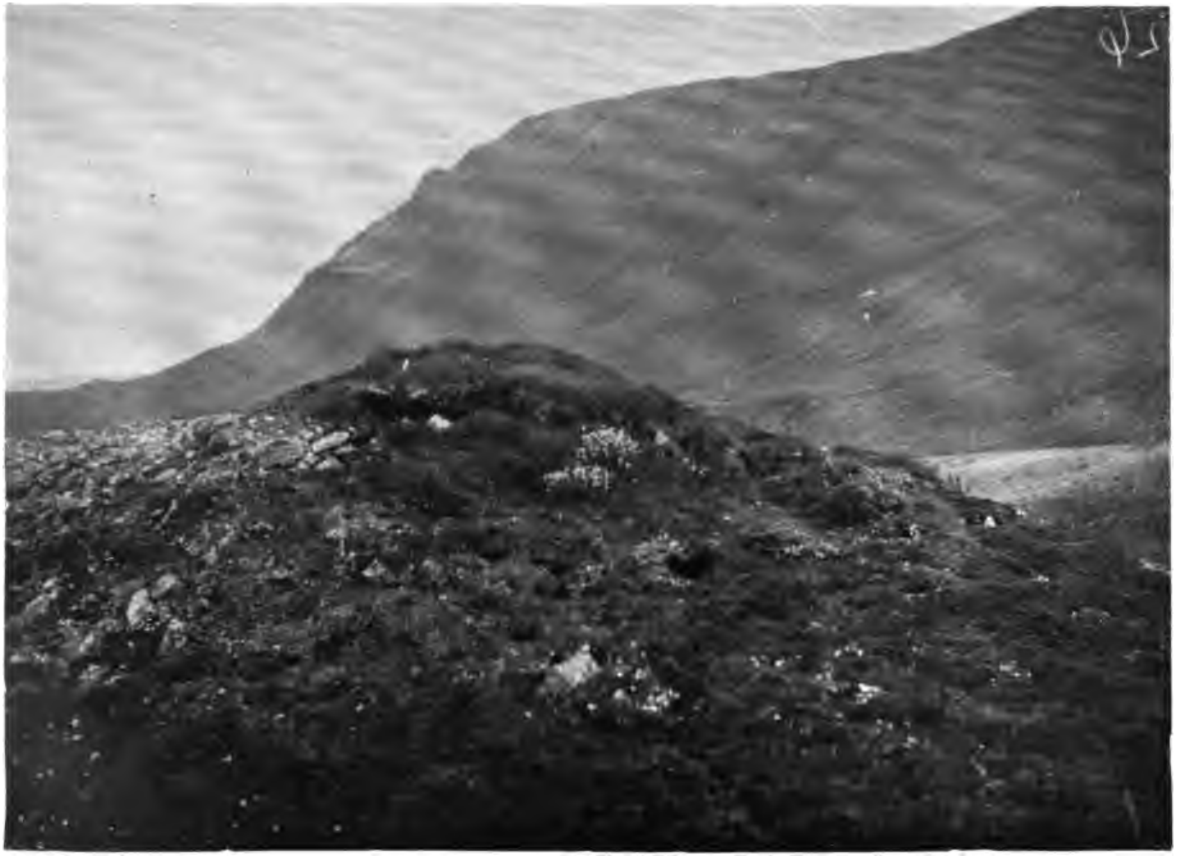
SAMOYEDS AT POMORSKY BAY.

flats at the head of the bay; but it is probable they have considerably increased since it was made. We were still on the west side, and apparently nearly two miles from the head of Meta Bay, when we suddenly ran aground. On examining the bay from a hill near, we saw that the whole of those two miles had been filled up with mud and debris brought down by a river beyond, the banks just showing at low tide, and covered with about two feet of water at high tide. Instead of gradually spreading out into the bay, the deposit ended with a steep face exactly like a tipping bank on a new railway. The shallow water continued much farther down the east side, for here it was joined by another accumulation, an immense fan-shaped mass of debris, three-quarters of a mile across, brought by a stream from a ravine called Edward Creek on the American chart. The ravine is narrow, with a very steep incline, and as the immense volume of water liberated by the spring thaw rushes down, it carries all before it, including rocks of considerable size; but as soon as the open shore is reached, and the water has room to expand, the pace slackens, and the rocks find a resting-place, until they choke the course of the stream, and force it to make a new channel. Some parts of the deposit had evidently been undisturbed for years, and carried dwarf willows with stems an inch thick—a large growth in these regions. In others the willows were lying uprooted through some new change in the direction of the stream. The whole formed a wonderful object-lesson of the denuding power of frost and water in the Arctic regions. But perhaps even a greater lesson was to be learnt from the "gravel heap," a mile lower down the valley, depicted in Plate 87, a fragment of similar deposit of ancient days, which has since been raised above the sea-level. Its height by aneroid was one hundred feet.

Curtis, Kjeldsen, Hansen, and I went up the valley, Kjeldsen bent on reindeer, for the crew of a Norwegian ship, which had been anchored in this bay some twenty years ago, had shot over a hundred during their short stay. But we never saw a hoof-mark or sign of them, beyond two or three old horns, shed probably years ago—an instance of the general decrease of large game here. Yet all the lower country carried much good grass, like Goose-Land. We walked about five miles inland and obtained a fine view of the country. To the west of the point reached was a large glacier at least a mile wide, coming down to the head of the valley and forming the source of the river which ran into the bay. On its surface were three lines of stones, one near the centre, the others about a hundred yards from the edges, so it probably consisted of two glaciers which had united higher up. Its upper part was shrouded in mist. To the ENE. were a group of mountains three to four thousand feet, and in all other directions others of less elevation, chiefly covered with snow, and many small glaciers showing in their valleys. When it is clear here the scenery must be grand, but constant storm clouds and rolling masses of mist caused my photographs to give a very faint idea of the general effect. After a sharp walk back of one and a half hours we had the pleasure of finding the launch hard aground! No doubt that rascal Larsen, who was left in charge, had gone to sleep, and woke too late to do anything but frame excuses. In the good old days I fear I should have given him three dozen right away, perhaps to his benefit. So we were kept two hours on that shore, wanting dinner, and not in the best of tempers. It was a quarter after midnight when we at last regained the ship. As the launch travelled well with the wind behind her, it must be about ten miles from Edward Creek to our anchorage, which distance nearly corresponds with the American chart.

July 29.—The 29th was a day of much wind, fog, and rain. Curtis and I landed, but only obtained a Red-throated Diver with two young, just showing a few quill feathers. The bird which stayed to look after the young was the male; the female came occasionally to see what was going on, but left again at once. The way to secure Divers in such a case is to fire every time they show their heads above water, whether within range or no, until they get confused, and come up near one of the guns. These birds were a puzzle. With the most careful search we could find no trace of their having nested

PLATE 56.



F. 11. 1/2 *S.* 2.15 *p.m.* 30-7-97.

SNOWY OWL'S NEST, *Nyctea scandiaca.*

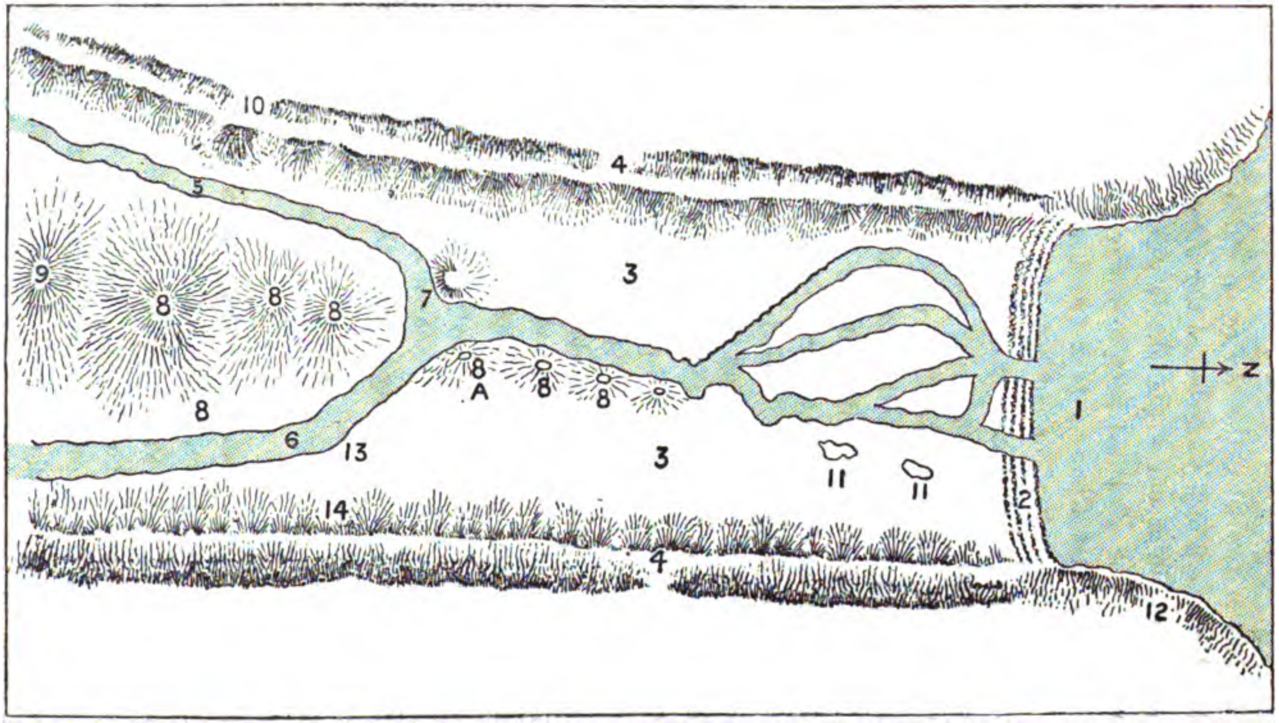
GUBINA BAY, NOVAYA ZEMLYA.

on the borders of the lake, the shores of which were very shallow. We waded in ten to fifteen yards before the water reached our ankles, and no stream ran in or out of the lake in which a Diver could swim, much less dive. The wind had been so strong from the north during part of the day, that Kjeldsen took two heavy ropes on shore to keep us off the shingle bank on our lee.

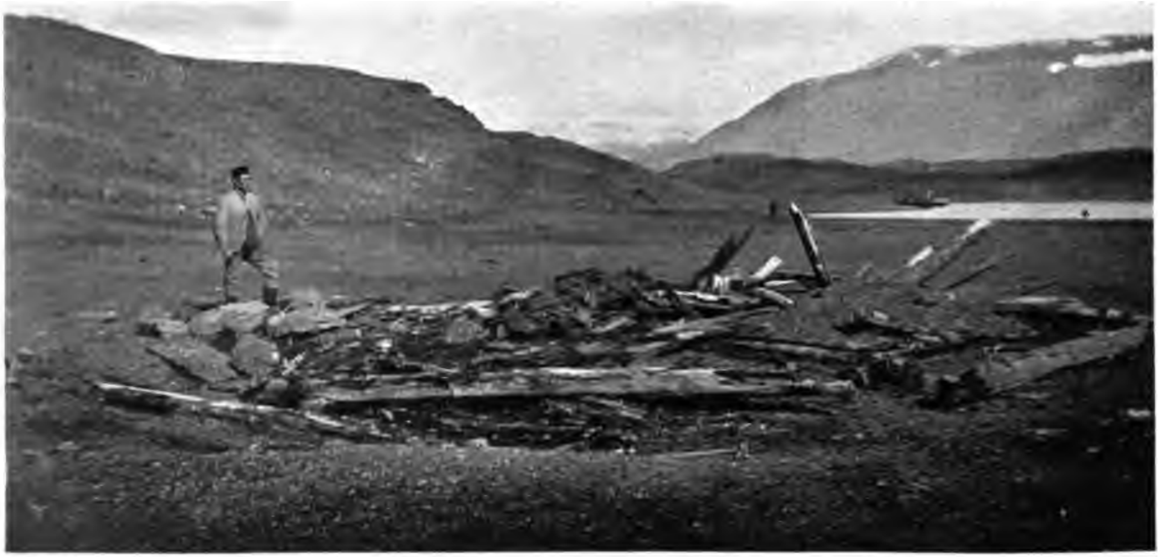
July 30.—The weather having improved and wind gone down, we crossed the Shar in the launch at noon, making for Gubina Bay, where Admiral Markham anchored in 1879. As we steamed along, splendid views opened in all directions, to the north up Belushja Bay, to east and west up the Shar, and south to Gubina Bay, all of them surrounded by mountains rising to three or four thousand feet. On landing, we found fresh spoor of reindeer, some of it looking little more than twenty-four hours old, and Kjeldsen at once started up the valley with great hope of sport. Flowers here were very fine, especially *Eritrichium villosum* and Iceland poppies. Many of the latter were ten to twelve inches high, and varied in colour from white through several shades of sulphur-yellow to deeper tones showing traces of a brick-red colour; but I have never seen them assume in the Arctic those fine orange tints we so often have in our gardens. *Saxifraga hirculus* was quite a feature in the scenery, making some of the lower ground look as yellow in the distance as an English field with buttercups. Birds were very scarce—only a Snowy Owl, two Ringed Plovers, and some dozen Snow-Buntings.

The plan on the following page will give some idea of the configuration of this valley.

1. Sea. 2. Shingle beach, showing several terraces, on the highest of which was a much decayed tree, 25 feet long and 15 inches diameter. There was considerable driftwood here, old and fresh; the launch was filled with it on our return. 3. Flat ground covered with debris, through the lower part of which the river spreads into several channels. 4. Bluffs rising on both sides of the valley to 1500 feet, with large masses of talus at their feet. 5. River coming



GUBINA BAY, MATYUSHIN SHAR.



F. 11. 1/2 *S.* 10.45 *a.m.* 3-8-97.

REMAINS OF ROSMYSSLOFF'S HOUSE AT SEAL BAY.

from the south-west, and draining a basin surrounded by mountains quite 4000 feet high. 6. River from south-east, larger stream than 5, and draining several valleys whose upper ends could not be seen from 9. 7. Cliff fifty feet high, and part originally of the hill on other side of the river. 8. Old nests of the Snowy Owl. The mounds on which these were placed formed part of a ridge whose lower end had been so denuded that only two large rocks (11–11) remained to indicate its former position. 9. Highest point reached, 650 feet above sea-level and four miles from the sea. 10. Waterfall over the edge of bluff from an upper snow-field, and having large fan-shaped mass of debris at foot. On the headland 12 were several very distinct terraces or old beaches. The rivers seemed to have occupied a fissure which had enabled them to cut a passage through the heart of the range, for the ground at 13 was higher than that at 14. United they carried more water than any river in Novaya Zemlya except the Neckwatowa.

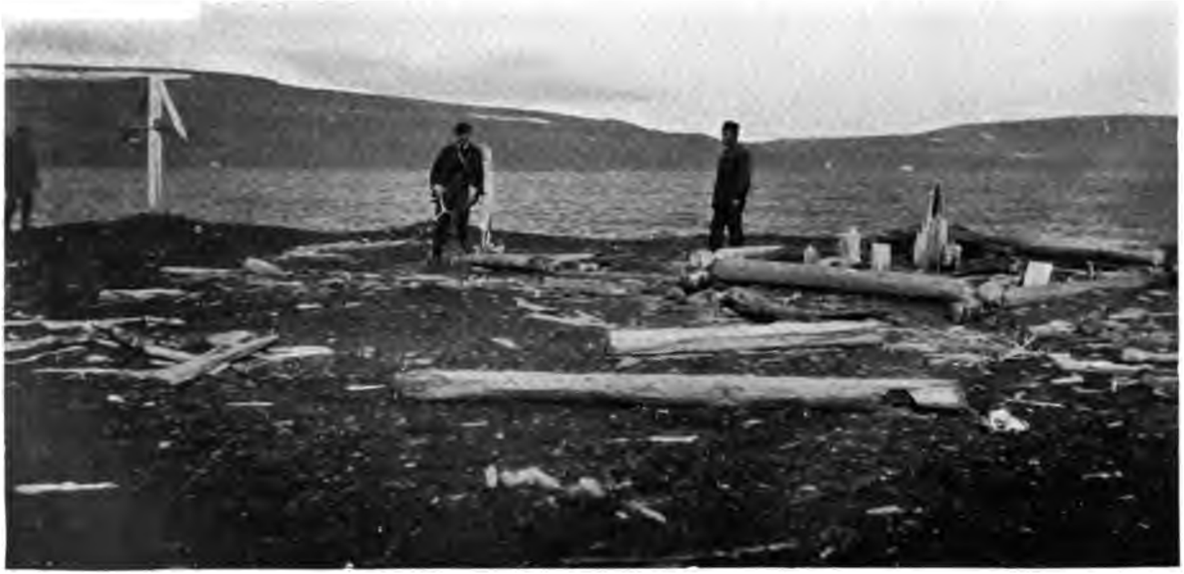
Plate No. 56 shows one of the mounds crowned by an old nest of the Snowy Owl. The grass surrounding the nest was luxuriant and dark green, evincing "high cultivation," and the prettiest groups of flowers grew on the slopes. But the mounds held a far greater attraction to the owls than flowers, for their sides were riddled with Lemming burrows; so the nests were placed over a living larder. We counted eight old nests, none of which had been occupied this year, although one or two had probably been used last season. They were holes scratched out a foot deep and twenty inches across, and contained no lining beyond a number of pellets and quantities of Lemming bones. Although burrows were so numerous, we never saw a Lemming.

We left the shore again at six o'clock, and having the wind behind us, reached the ship in fifty-five minutes. When crossing in the morning the thermometer was 53°, and on the return voyage it showed 47°; but it appeared much cooler when walking up the valley, for we met a strong south wind coming off the snow-fields of the interior, which made photographing difficult, and obliged two men to hold the stand of the camera. As we neared Seal Bay sixty or seventy geese rose from the shore, chiefly White-fronted, we thought.

July 31.—The morning being wet, dull, and uncomfortable, we stopped on board, and in the afternoon had a walk up the east side of Belushja Bay to within a mile of Edward Creek. Curtis saw a Shore-Lark, the first we had met with on Lütke Land. The wind to-day again came down the valley, but from the north, and was as cold as yesterday. Seal Bay may well be so tempestuous with four such funnels to accentuate every wind that blows.

August 1.—The next day Feilden and I walked to the east point of Belushja Bay, as we wished to examine some red rock, which forms a conspicuous landmark when entering the bay from the west. It consisted on the surface of thin pieces of shaly slate varying from a deep brick-red to pale shades; but this was only on the surface of each piece, the interior being a light grey. The slate was brittle, and crackled under foot as if it had been burnt; few fragments exceeded $\frac{3}{16}$ inch in thickness. Turning to the east, we climbed up a hill which is very prominent on entering Belushja Bay. During the ascent Feilden noted an interesting old coast-line, containing many marine shells, at an elevation of 500 feet. When we reached the top we had a clear view of twenty miles over the Kara Sea, and no speck of ice was in sight. Crossing to the next ridge, we obtained a view of the country to the east of Seal Bay. Its surface consists chiefly of stones and mud, many small tarns fill the hollows, and one rises to the dignity of a lake more than a mile long. The shores of the lake are visited by large numbers of geese, as shown by the quantity of droppings and moulted feathers.

August 2.—On the 2nd the weather was thoroughly bad all day, with much rain and a cold east wind, changing to north. However, Curtis and I decided to face it, and took the launch down the Shar to the east, keeping under the north bluffs. During the first three or four miles the strata of the rocks were most fantastically crumpled,



F. 11. 1/5 *S.* 1.50 *p.m.* 9-8-97.

REMAINS OF ROSMYSSLOFF'S HOUSE AT WOOD CAPE.

in one case the upper resting on the lower at right angles, and both at an angle of 45° from the level, thus forming a V. As we proceeded they became more regular, rising at 45° from east to west. Eight miles from Belushja Bay we came to the Notschujew River, a considerable stream, which drains a large valley running nearly due north. Camped on the shingle bar were the Samoyeds who had lately left Seal Bay; they said the weather had been so bad they could not continue their voyage, and were waiting in the tent shown on Plate 64 for the sea to become smoother. At the time the photo was taken the wind was so high two men held the stand down, and so cold it chilled us to the bone; yet those Samoyeds seemed fairly comfortable with no fire, and that wretchedly thin canvas their only shelter. It shows how thoroughly adapted their skin costumes are to the climate. The men had been up the valley, but could find no reindeer, and the whole party were getting rather short of provisions. We walked some mile and a half up the side of the river, and thought the flowers were rather later here than at Belushja Bay. *Ranunculus Pallasii* was growing freely in some of the pools, the first time I had seen it since leaving Waïgatch. I find no note of birds in this valley, so expect they were scarce, and none calling for remark. The wind had now changed again to the east, and helped us materially on our homeward way. During our absence Pettersen had discovered some skeletons on the promontory close to our anchorage, also part of a board bearing an inscription carved in Russian character. These remains first drew our attention to the fact that we were in the harbour occupied by Rosmyssloff during his survey of these coasts. As the interest of the remainder of our voyage was greatly increased by this discovery, and by the fact that we were following the course of another great Russian explorer, Pachtussoff, I propose to break my narrative here and give an account of what these two Russians accomplished in these seas.

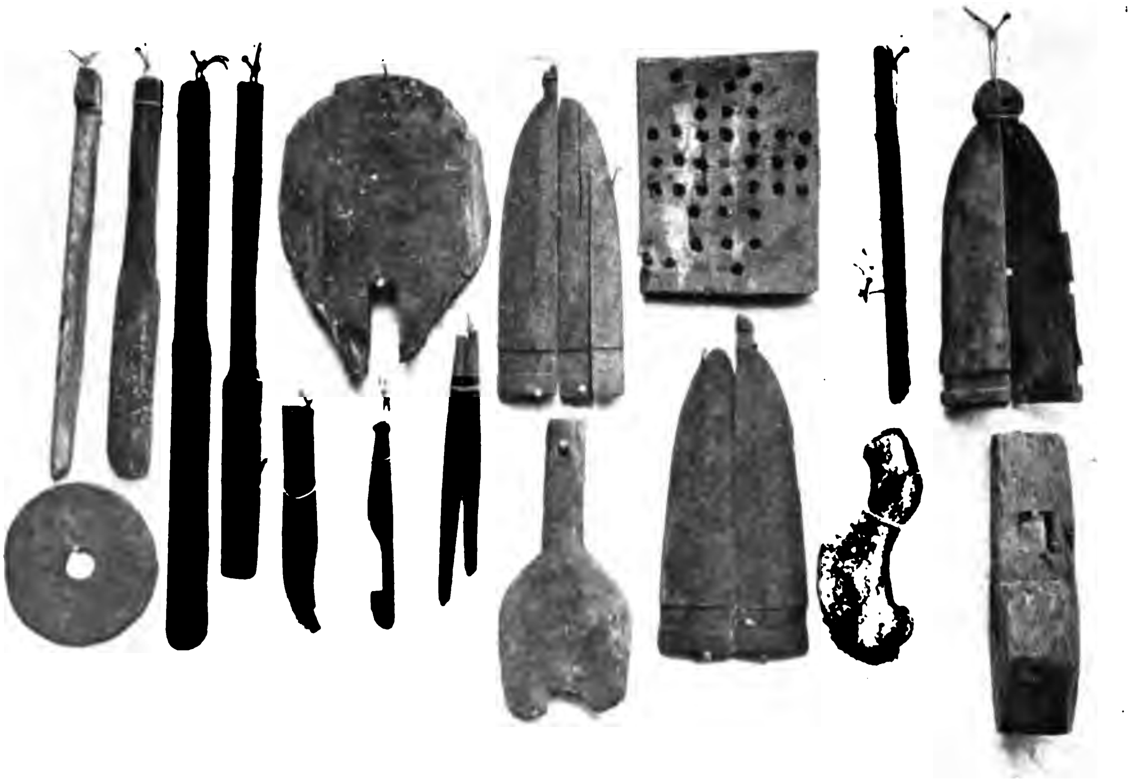
CHAPTER IX

RUSSIAN EXPLORATION

THESE particulars of the work accomplished in Novaya Zemlya by two of Russia's most energetic explorers are taken from Spörer's "Novaya Semla." In recounting what these men accomplished, and omitting the exploits of others, I trust it will be understood that it is caused by no want of appreciation of the work of Barents, Lütke, and many other names associated with these seas. I give their history only because we visited so many places made memorable by them, and to contrast the more favourable conditions we enjoyed.

An opinion had long been held by some of the leading Russian merchants that valuable silver and other ores existed in Novaya Zemlya; and in 1768 Lieutenant Rosmyssloff of the Imperial Fleet received the command of an expedition, organised at the joint expense of the Government and a merchant named Barmin, to survey the coasts and its islands and search for deposits of minerals. For this purpose he was provided with a small three-masted vessel of ten tons—surely there must have existed a different system of measurement in those days!—and a crew of thirteen; the Government sending a steersman or pilot and two sailors; and Barmin, Pilot Jacob Tshïrakïne, with nine sailors. The officer whose designation we translate as Pilot holds a more important position in the Russian service than his namesake does in the English. After encountering several violent storms which greatly delayed his voyage, Rosmyssloff sighted Goose Land on August 3rd, and sailing up the west coast, anchored at the entrance of Matyushin Shar on the 14th. During the next fortnight he and Pilot Gubin—after whom Gubina Bay is doubtless named—made

PLATE 59.



RELICS FROM ROSMYSSLOFF'S HOUSE AT SEAL BAY.

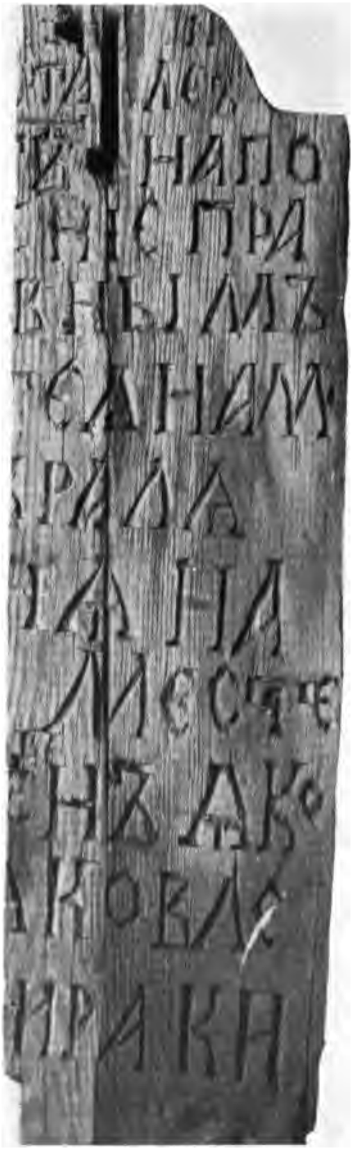
extensive surveys in the Shar, and on the 30th of August he reached its eastern entrance, where he climbed a high mountain (probably that we also used for the same purpose on August 1), and obtained an extensive view over the Kara Sea. As far as the eye could reach it was free from ice. The unseaworthiness of his vessel prevented his taking advantage of this favourable opportunity. Having resolved to winter in Seal Bay, he erected there a wooden house, brought for the purpose from Russia; but as this was not large enough to accommodate the whole crew, he transported some old hunters' huts from the western part of the Shar, and constructed from them another house on Wood Cape, a shingle bank projecting into the Shar from its south coast, five miles to the east of Seal Bay. Kjeldsen tells me this practice of dividing the crew is still often resorted to by the Norwegians in Spitsbergen, as it increases the chance of obtaining game during the winter. Here they went into winter quarters on September 7. On the 20th the straits were full of ice, and on the 25th the Kara Sea also. On the 27th of October the sun disappeared below the horizon, only to reappear on January the 24th. Terrible cold, continued snowstorms, and enormous snow-drifts would not allow the men to leave the hut; the want of exercise combined with vitiated air and confined space soon induced much sickness, and Jacob Tshïrakïne died, November 17, after long suffering. On the 31st of January some of the men at Cape Wood saw a herd of reindeer on the coast, and taking their guns, started in pursuit to shoot as many as the good God meant for them; but a sudden snowstorm overtook the poor men and buried them alive. At the end of May the snow began to melt, but in the middle of June the ice was still so dense on the Shar that Rosmyssloff determined to complete his survey from it. Although principally occupied with this work, he kept a keen eye on surrounding Nature, and reported that the mountains on either side of the Shar consisted chiefly of slates, and contained no precious stones, valuable ores, or marbles of any kind. Neither were there salt lakes or springs, but many fresh-water lakes abounding with small fish.

Trees could not grow on account of the shortness of the summer. Of animals there were great herds of Reindeer, many Ice-Foxes, Wolves, and White Bears; of birds there came in the early spring flocks of Wild Geese, Gulls, and Jays (?); and of sea-beasts there were Walrus, Seals, and Dolphins.

On August 2nd the Shar was again free from ice. Although the intrepid explorer had lost seven men out of his crew of thirteen, and was himself seriously ill, he determined to make an effort to reach the Siberian coast, and decide the distance between it and Novaya Zemlya. Favoured by a north-west wind, he sailed into the Kara Sea, but the following day encountered much drift-ice; shortly after, his frail vessel struck so heavily on a floe, she sprang a dangerous leak and he was obliged to put back. Rosmyssloff again sighted Novaya Zemlya on the 4th, and entered what he thought was Matyushin Shar, but which proved to be a bay to the north, named by him Salin Nesnæmy or Unknown Bay. The state of his vessel and crew forbade any attempt at exploration to the north, and obliged him to return to the Shar. He anchored at the mouth of the Matyushin River on August 8th, and endeavoured to patch up the leak in his crazy ship. Fortunately he was joined here by a hunting vessel, whose skipper persuaded him to abandon his ship and return with him. They started for home on the 25th, and encountered much ice shortly after they left the straits, which caused them considerable trouble for the next forty-eight hours; escaping safely from it, they reached Archangel on September 8, 1769. Thus ended the most important voyage in these seas since that of Barents.

And now let me give a short account of the traces we found of Rosmyssloff's expedition 129 years after he decided to winter in Seal Bay, a decision which itself showed him to be a man of no mean ability, for it was far the safest harbour we saw in all Novaya Zemlya. We first went up to see the graves. Carefully removing the remaining stones and wooden lid, there lay the skeleton of Jacob Tshïrakïne, a man 6 foot 3 or 4 inches in height, for his femur measured 19 inches

Plate 60.



FRAGMENT OF WOODEN TABLET ERECTED BY PACHTUSSOFF'S PARTY IN 1835, IN MEMORY OF PILOT TSHÏRAKÏNE.

and his coffin 6 feet 6 inches inside. Probably a tall thin man, without any special strength in proportion to his height. Curtis noticed his bones were smooth, and showed no signs of any ligaments of great power having been attached to them. His teeth were in splendid order. The coffin must have cost much labour, for the boards had been carefully hewn, and the lid hollowed out with an adze to a depth of 2 inches. Near to stood an ancient post, still showing notches where the three other parts of a Russian cross had been originally fastened; and the fragment of head-board, picked up by Pettersen a few yards away, had no doubt been fastened to it by Pachtussoff or his crew; but the post was far older than the head-board. A photograph of the latter is given on Plate 60. After my return I sent a copy to M. Jules de Shokalsky, Secretary to the Russian Imperial Geographical Society, and he most kindly returned an English translation with the probable contents of the lost part. He writes: " This is a slab written in old Slavonic characters, erected in memory of the death of Jacob Tshïrakïne, who was one of the men of Rosmyssloff's staff, a wheeler (steersman) on his little ship. I have read in the authentic log of Rosmyssloff, in the archives of our Naval Ministry, that this man died on the 17/29 November 1768 at their winter house in Seal Bay. I can tell you that the inscription is dated from the year 1835 (February ?—the date is lost with the left portion of slab), and the sense of the inscription proves it to have been erected with the intention to point to all travellers the place where Tshïrakïne died. We know that in the year 1835 Pachtussoff passed some time in Matyushin Shar, and the plausible explanation is, this board was erected by his staff."

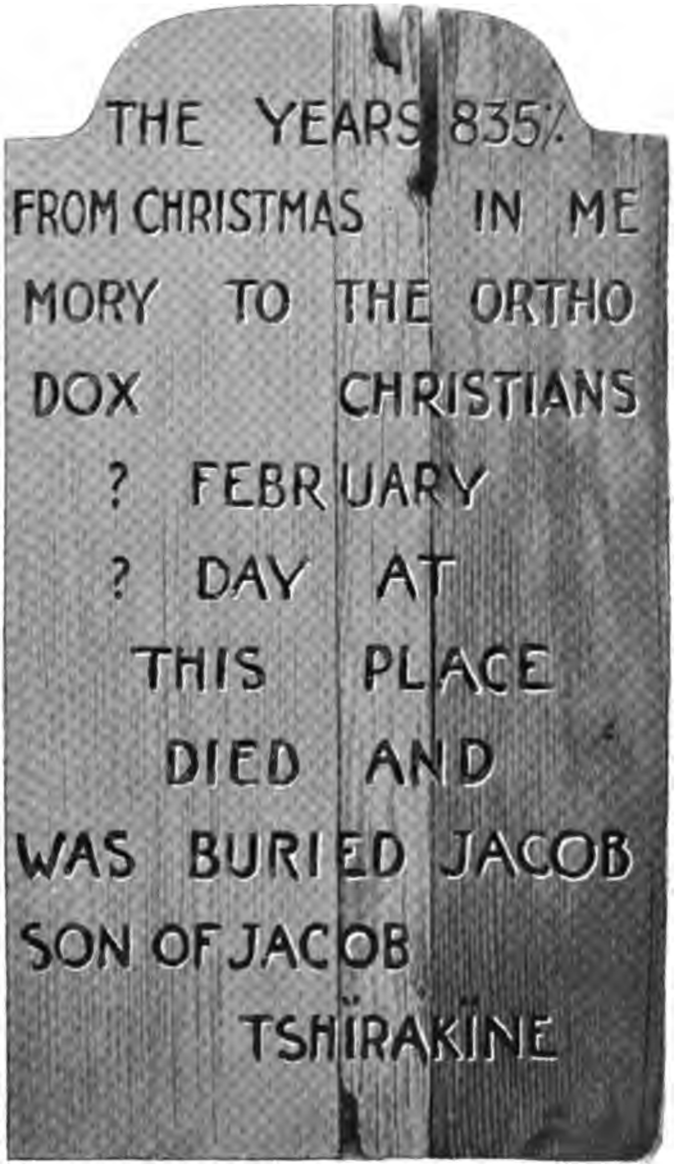
We carefully replaced the coffin lid, and built up a pile of stones over it that will resist the weather some time. Close to was the skeleton of another man, buried without a coffin, the second who died in the hut that winter; and at the end of the point were five more, also without coffins, no doubt belonging to those men lost in the snow, whose bodies had been recovered after the thaw and buried near their companions.

When first entering the bay, we had noticed the ruins of a small hut on the shingle bay, but thinking it was only the remains of some hunter's shelter, had paid little attention to it. Under the light of our recent discoveries, we now felt sure this was the hut erected by Rosmyssloff, and it was more carefully examined. Only a few logs remained *in situ*, protected by the shale which had drifted round them; from these we found the hut had consisted of two rooms, the outer 12 feet by 12, and the inner 14 feet by 14; the latter containing a brick fireplace. Plate 57 shows all that is now left of this hut. One of the men turned over the shingle covering the interior, and found various curious old relics, some of which are given on Plate 59; some broken earthenware, a piece of matting, a carpenter's square, and several talley sticks were also uncovered. It is wonderful these things should be in such good condition after 128 years exposure.

As we returned from the Kara, I stopped to photograph all that is left of the house on Wood Cape. The tablet to the left of Plate 58 was erected by the Russians in 1889 to commemorate Rosmyssloff's stay here.

Before proceeding further I will add some extracts from Spörer respecting the man who put up the small tablet in Seal Bay, and whose footsteps we were shortly to follow up the east coast.

In 1832 two merchants of Archangel, named Brandt and Klokoff, determined to equip an expedition to Novaya Zemlya for the combined purposes of finding a route through the Kara to the River Obi, general discovery, and hunting. They offered the command to Lieutenant Pachtussoff, who gladly accepted it. Three vessels were prepared for the voyage, the largest, in which Pachtussoff sailed, measuring 42 feet in length, 14 feet wide, and 6 feet deep. Fore and aft were covered in to form cabins, and the space between protected by sail-cloth. Having experienced once or twice what Barents Sea is capable of in bad weather, I have often wondered how such a vessel ever reached Novaya Zemlya. Leaving Archangel on August 1st, they sighted Novaya Zemlya on the 10th, and met with such unfavourable



THE YEARS 835⁄.
FROM CHRISTMAS IN ME
MORY TO THE ORTHO
DOX CHRISTIANS
? FEBRUARY
? DAY AT
THIS PLACE
DIED AND
WAS BURIED JACOB
SON OF JACOB
TSHÏRAKÏNE

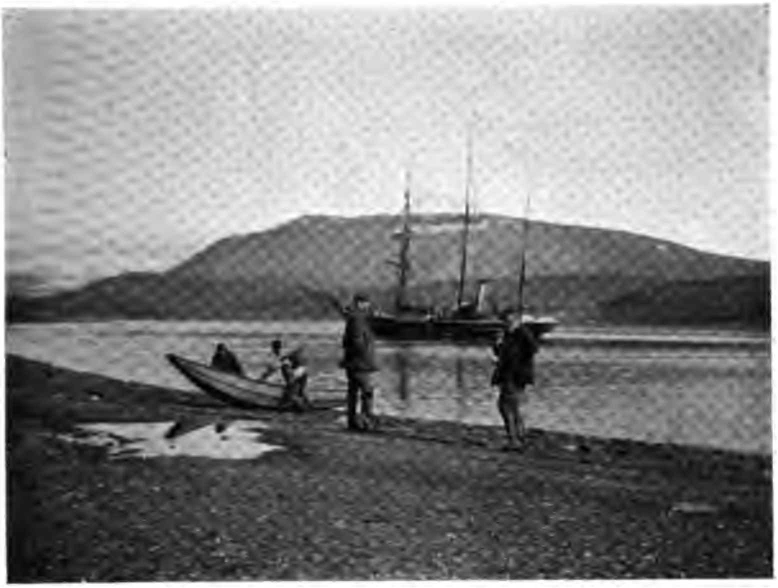
TRANSLATION OF TABLET BY M. JULES DE SHOKALSKY.

ice conditions they were obliged to postpone the principal objects of the expedition and devote their time to surveying the southern coasts of the island, where they wintered. Pachtussoff appears to have taken the best precautions to keep his men in good health, attending to their exercise and cleanliness with the care of a modern commander; but in spite of all, scurvy attacked them and two died; while two others were killed in a bear-hunt. On May 15th the first Geese were seen. The summer was occupied in sailing up the east coast of Novaya Zemlya, surveys being made of the various bays and headlands. On August 13th they entered Matuyshin Shar, but found no trace of their companion-ship, which they hoped to meet there. Although a north gale of three days' duration had now swept the Kara clear of ice, the health of the crew and shortness of provisions forbade any further exploration up the east coast of Lütke Land, with the probability of spending another winter in these regions. Pachtussoff therefore turned to the west through the Shar, visiting Rosmyssloff's house in Seal Bay, the place his companions proposed to winter at. He passed the western entrance of the Shar on August 19th, and reached Kolguev on the 25th. The ship was in such bad condition that he made for the Petchora River, and returned overland to Archangel, arriving there November 21, 1833. No news had been heard of Lieutenant Krokoff, but the hunter Gwosdarew had reached Archangel with a full ship-load. The Russian Government decided to send another expedition, consisting of two small vessels, to Novaya Zemlya in the following year (1834), and this was placed under command of Lieutenant Pachtussoff. Pilot Ziwolka commanded the second ship, the total number of officers and crews being seventeen men. The ships left Archangel on July 24th, and, encountering much fog and bad weather, became separated until August 26th, when they met in Matyushin Shar. Till September 12th they were occupied in endeavouring to force a way through the Shar, but finding a solid block of ice to the east of the Farassowa River (it had doubtless been packed into the large space at the junction of Belushja Bay and Gubina Bay with the

Shar, until it could neither advance or retire), Pachtussoff decided to return through the Shar and winter at the mouth of the River Tschïsikïna. Here they erected a house 21 feet by 16 for the men, and another 12 feet by 10 for the officers, using part of Rosmyssloff's old ship for the purpose sixty-five years after it was abandoned. During the winter eleven Ice-Bears were killed, one on the roof and one on the threshold. In April 1835 the crews were divided into two parties, provided with sledges, one under Pachtussoff proceeding to survey the south coast of the Shar, and the other, under Ziwolka, the east coast of Lütke Land. Ziwolka found the travelling good over the smooth ice in the Shar, but when he entered the Kara Sea, his difficulties were immensely increased by the hummocks and icebergs—some of the latter 70 feet high. Pushing on towards the north, he passed three large bays which he named Cancrin Bay, Unknown Bay (Salin Nesnæmy), and Bear Bay, but had not time to explore them. On April 24th the expedition rounded Five-finger Cape. Finding provisions running short and the ice rapidly loosening from the shore, they were compelled to return, erecting first a cross with inscription recording their visit; and reached the winter quarters on May 6th after an absence of twenty-four days. During their journey they noticed numerous tracks of Reindeer, Ice-Bears, and Foxes; they saw two Snowy Owls, Gulls (Ivory Gulls?), and Divers, but no Snow-birds (Snow-Buntings?). Many Seals were on the ice, but no Walrus. There was plenty of driftwood, which generally lay on the north sides of the projecting capes, often piled ten feet high. Near Bear Bay they saw stranded on the beach a Larch eighty feet long and three feet thick.

The west entrance of Matyushin Shar was not clear of ice that year until June 29th. Pachtussoff sailed the following day to explore the west coast of Lütke Land, and endeavour to round the north of the island; but his ship was wrecked in the ice on July 9th to north of Admiralty Peninsula, and the party escaped with difficulty to Berch Island in their boats. Fortunately a hunting Lodka

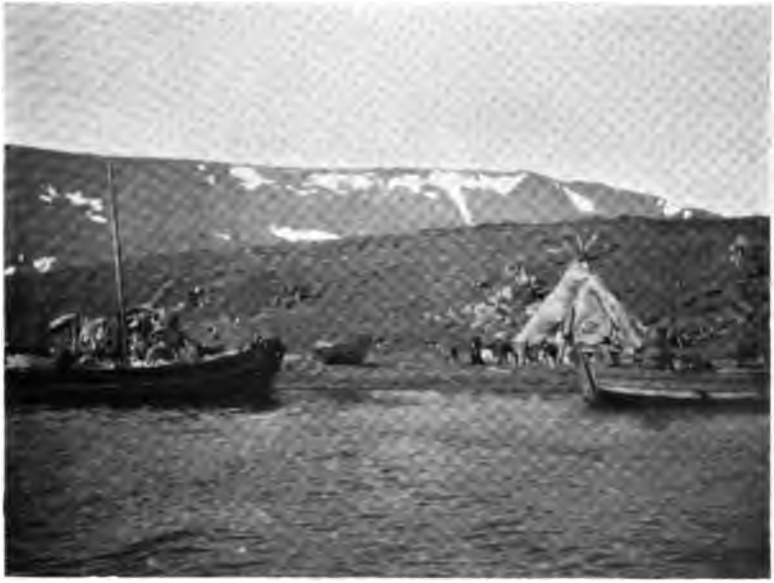
PLATE 62 A.



S.S. "LAURA" IN SEAL BAY.

FROM PHOTO. BY MR. F. CURTIS.

PLATE 62 B.



SAMOYEDS ENCAMPED IN SEAL BAY.

FROM PHOTO. BY MR. F. CURTIS.

appeared next day, whose captain took them back to their winter quarters, arriving there August 9th. Pachtussoff now endeavoured to reach the north of the island by the east coast, and fitting out another small vessel (borrowed from Burgher Tschelusgin), sailed eastward on August 10th with six men. After encountering many dangers from the ice, often sheltering behind stranded bergs and projecting spits of land to escape its extreme pressure, he at last reached the island named after him, in lat 74° 24′. Here his further progress was completely barred by the ice; so returning August 28th, he regained the Shar in safety. During his absence Ziwolka had fitted out the schooner in readiness for the voyage home. They set sail September 3, and reached Solombola October 7, after an absence of 440 days. Two men had died in Novaya Zemlya, the rest, except their commander, returned in good health. The strain of the voyage, its anxieties and exposure, had been too much for him, and he died a month after his return to Archangel.

CHAPTER X

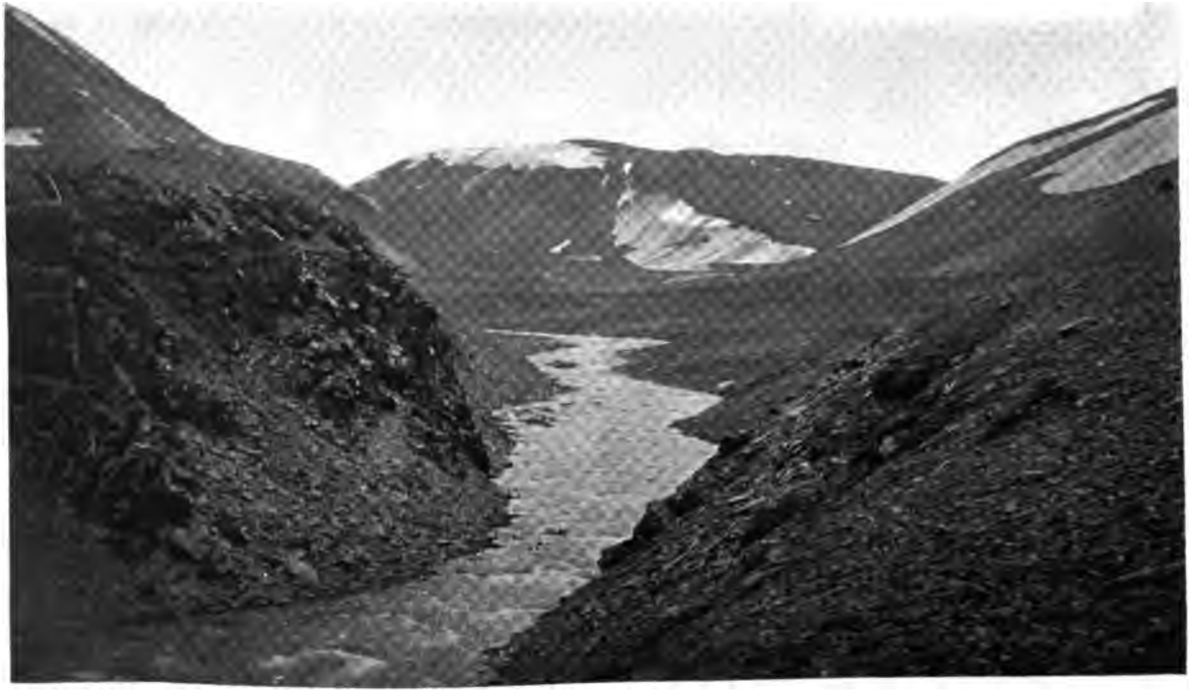
LÜTKE LAND AND NOVAYA ZEMLYA

AUGUST 3.—Trusting this long digression may be forgiven, I now return to our personal experiences.

The 3rd of August opened bright and sunny, permitting us to take a few photos near the ship; but this happy state of things soon passed away, and was replaced by wind, heavy clouds, and a bad light; all unfavourable for the proposed excursion to the Farassowa River. This river runs into the Shar on its south side, to the west of Gubina Bay; and at its mouth Palliser anchored in 1869. Landing on the west side of the stream, we walked up the valley for a mile and a half, and found it most desolate as regards both animal and vegetable life. Not a trace of reindeer was to be seen. Birds were very scarce, I doubt if there were two dozen in the whole valley; two Purple Sandpipers, two Ringed Plovers, and a few Snow-Buntings, were all we met with. Plants were equally rare, and those we saw were dwarfed and poor. The chief thing of interest in the valley was a deep band of iron ore, clearly marked up the greater part of the east side of the valley, at a height of 500 or 600 feet above sea-level; and also showing in places on the west side. But when all the difficulties connected with working these deposits are considered—even should they prove rich in metal—it is evident that iron must approximate much more nearly to the value of gold before they can have any commercial interest. Plate 63 shows a passage the Farassowa River has cut through the rock, and illustrates several similar scenes in the Gubina Valley.

On our return in the evening the sea had risen, and gave us a

PLATE 63.



F. II. 2 *S.* 5.50 *p.m* 3-8-97.

FARASSOWA RIVER, MATYUSHIN SHAR.

1½ MILES FROM SEA. ELEVATION 190 FEET.

good bumping and thorough wetting; the launch was a staunch little boat, however, and was perfectly safe in any ordinary sea.

August 4.—The next day was one worthy of even this wind-swept spot. Lying in our tiny harbour, we needed two anchors and two ropes to shore to keep us off the shingle bar on our lee. The gale first came from the north, then veered round to the west, finally returning to the north. We shall not easily forget how it howled through the rigging that day. One shore rope broke under the strain, but was mended fortunately before damage to the ship ensued. My aneroid stood at 29° 0′ 7″, and the thermometer at 44°; the latter a fall of 8° from the previous day, when the wind was also north. The ship was the best place to be in to-day, and we stayed there.

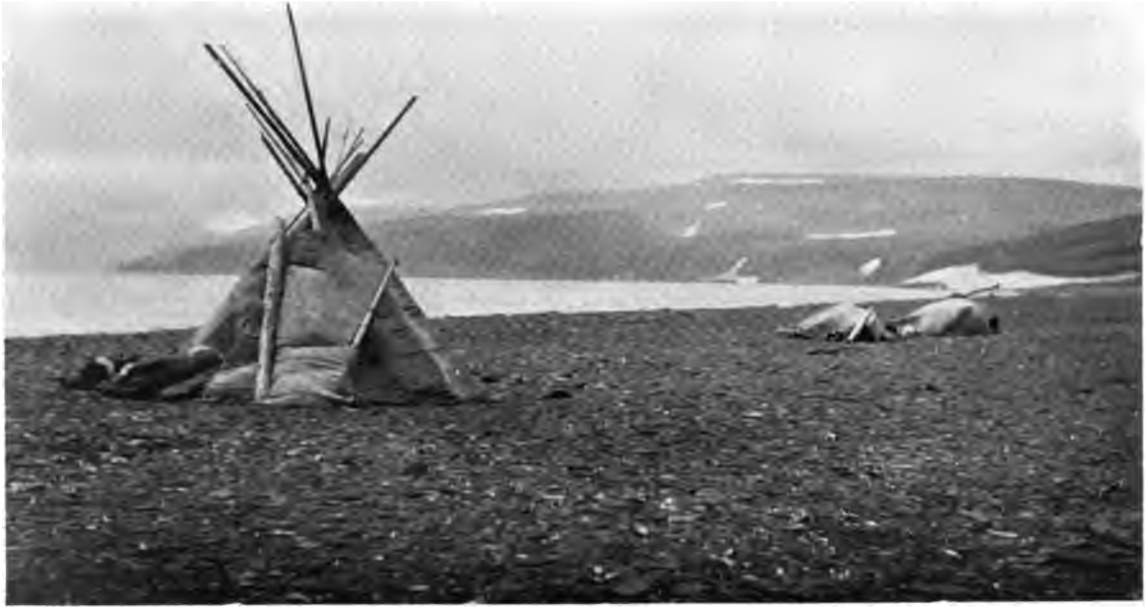
August 5.—The storm had blown itself out during the night, and although the weather was still far from perfect, it was possible to land to-day. Feilden and Curtis saw a nearly pure white Snow-Bunting.

Having decided to make an attempt to enter the Kara Sea, the anchor was raised at 3 P.M., and we steamed down the Shar to the east. As we passed the Notscheyew River, we noticed the Samoyeds were still there. At this part of the Shar the south coast has four very distinctly marked old beaches, the highest 500 or 600 feet above present sea-level; they are also continued for some distance up the east coast of Lütke Land. Passing the headlands at the east entrance of the Shar, the Kara Sea lay stretched before us without a speck of ice visible in any direction—even from the mast-head; and a long gentle roll swept over its surface from the north, telling of the absence of any quantity of ice for many a mile in that direction. Of course the wind was also from the north and dead ahead! We had now become so accustomed to this as part of the natural order of things, that we knew something had gone wrong when the engine stopped; it was absurd to suppose the wind was favourable.

August 6.—During the night we had been steaming up the coast, a low flat shore of tundra character, rising in terraces to a height of 600 feet, and backed by the lofty mountains of the interior. When

Kjeldsen called me at 6 A.M., it was one of the most perfect mornings, a brilliant sun, sky almost without a cloud, a deep blue sea dancing in the sunlight. The temperature in the shade was then 48°; at 10 A.M. it was 50°, and at 1 P.M. 52°—the thermometer facing north, and a north wind. The sea-water at surface registered 40° at 1 P.M.

On our port side rose range after range of fine mountains several thousand feet in height, their sides covered with snow, and their valleys filled with immense glaciers, which flowed like great frozen rivers, several miles wide, into the head of every bay; the whole lit up by the bright sunlight, and standing out sharp and clear in every detail. We passed the entrance of Bear Bay at 10 A.M., and I have ever regretted since I did not then steam up the bay to take advantage of the beautiful weather, and obtain clear pictures of the interesting scenery there. Such opportunities are too rare in these regions to be lightly missed, even for the sake of pushing on towards the north. We met several small icebergs as we passed up the coast, all of them evidently of fresh-water ice, split off from the glaciers, and showing most beautiful shades of the clearest blue. At noon a Fulmar and seven Arctic Terns were round the ship. During the afternoon Kjeldsen brought all on deck with a cry of "Walrus." To several of us this was our first introduction to the animal in its native home. We saw a large female lying stretched on an iceberg ahead, and in the sea alongside was a young one bobbing up and down in its vain endeavours to climb the slippery side of its mother's resting-place; the youngster felt the want of the splendid climbing-irons that the old Walrus possessed in her long ivory tusks. An Ivory Gull stood on the ice beside the Walrus—a new bird to Curtis and myself. The ship's course was turned in the direction of the ice, but before we could get within shot the old Walrus slipped off into the sea to join its young, gave vent to a few angry roars, and dived. Of course we gave chase, but it was soon clear that the *Laura's* speed contrasted very unfavourably with even that of the young, and our efforts to come up with them mere waste of coal.



F. 11. 1 *S.* 2.0 *p.m.* 2-8-97.

SAMOYEDS' ENCAMPMENT AT THE NOTSCHUJEW RIVER.

Between 5 and 6 P.M. we were making for Pachtussoff Island. The approach from the south is well marked by a hill on the mainland, 800 feet high, with very distinctly mammillated top. Running into the large bay, we found a good anchorage on the west side of Pachtussoff Island with five fathoms of water, well sheltered from all winds except those from south-west to north of west. Kjeldsen at once took a boat to examine the passage or inlet near which we were. Like Seal Bay, two shingle bars projected, one from either shore; between them was a passage amply wide and deep enough for a ship like the *Laura;* and beyond these points he found water varying from five to fifteen fathoms in depth, which afforded a perfectly secure anchorage in all winds. But the most interesting point about this inlet was that it completely divided the island into two parts; for Pachtussoff's chart shows it as one island. The explanation of this is doubtless that the passage was blocked with ice, and so covered with the remains of the last winter's snow at the time of his visit, that he failed to detect the character of the valley. And small blame to him either! Even a summer voyage in these regions is enough to show that sweeping criticisms of previous explorers' work are unwise. Atmosphere, snow, and ice so vary the appearance of the country, especially when viewed from a distant point, that the most careful observer may well be deceived as to which is sea and which land.

Leaving Kjeldsen to investigate the sea portion, we landed on the western and smaller part of the island. Its two summits were crowned by cairns, probably erected by Pachtussoff. We first went to the higher one towards the south, which stands up as a distant landmark on entering the bay, and is 130 feet above sea-level. From this point our course up the bay lay due south; the other entrance east by north, and "Ibis" Glacier—of which more anon—west by north; the ship below us lay ESE. The northern entrance of the bay appeared to be full of bad reefs, just showing above the water at low tide; in fact, about as undesirable a piece of navigation as could well be imagined.

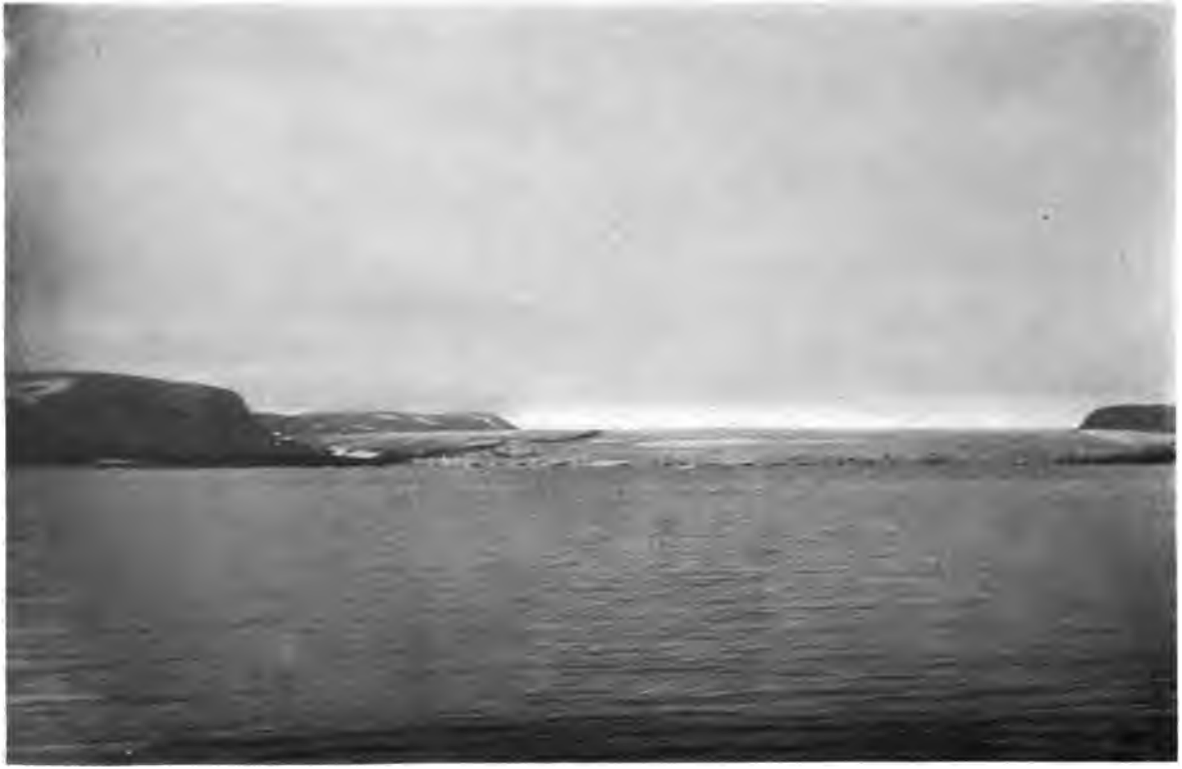
We took down all the stones of the cairn, but found no record of those who had erected it. A large new cairn was placed over a bottle containing a notice of our visit, and now forms a conspicuous landmark, visible when some miles at sea. Still, beacons directing to anchorages, which are clear of ice once each hundred or two hundred years, can scarcely be said to be of great practical use.

And then, as ill-luck would have it, Curtis and I crossed over to the larger island, for we missed our one chance of seeing an Ice-Bear. Ten minutes after we left, Daniel softly whispered in Feilden's ear, "Ice-Bear." And there, across a channel some three hundred yards away, was Bruin earnestly watching them. Unfortunately his sense of hospitality and right feeling were sadly deficient. Instead of waiting for Feilden to cross the strait, to welcome him in these almost unknown regions, he scuttled off with a long shambling gait; and when at last the visitors succeeded in crossing the water, and followed him up towards the end of the island, they only saw a distant speck in the sea, the bear making rapidly for some outlying islands, too far off to be attempted in their small boat. The Bear had been on short commons, living on grass for some time.

Vegetation was sparse. There was much driftwood on the shores of all the inlets, some far above the present tide line, the remains of trunks thirty to forty feet in length. Although there is no note of it in my diary, I remember being struck with the fact that most of the driftwood here was old, and too rotten to be of any service for building purposes, or even for firewood. I expect there are many seasons when the ice prevents any wood reaching the shores of this east side of Lütke Land. Doubtless this also accounts for the fact that we saw no Brünnich's Guillemots at the eastern end of the Shar, or on the east coast of Lütke Land. Kjeldsen told us he had noticed, both in Novaya Zemlya and Spitsbergen, that they never laid their eggs till the ice had left the shore.

Birds were scarce on the islands. Two or three Snow-Buntings were seen, assuming their autumn plumage, and traces of Snowy Owls

PLATE 65.



F. 11. 1 S. 8.0 *p.m.* 7-8-97.

"IBIS" GLACIER. ZIWOLKA FJORD, FROM SHIP,

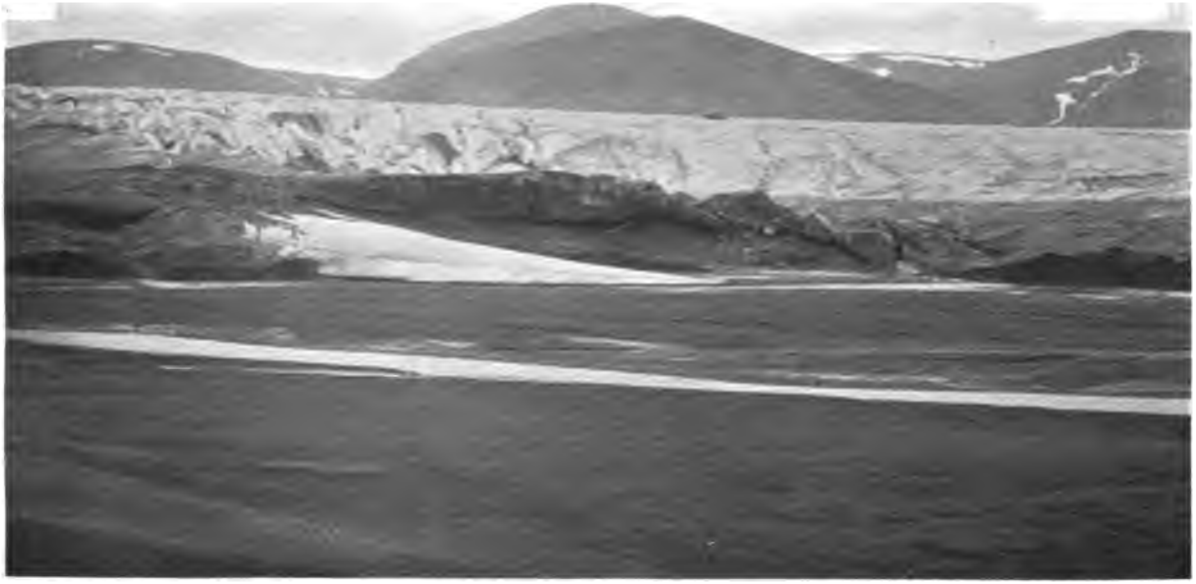
remained on several mounds. Fifteen Grey Geese left the island as we landed, also some Eider; but both were too far off for identification. An Ivory Gull and a Black Guillemot *U. mandti* were shot. Three more of the latter species were on the sea. A Pomatorhine Skua came within twenty yards of us as we returned to the ship, and several Glaucous Gulls passed us in the bay. We saw two pairs of Red-throated Divers on tarns. They had no young with them, neither could we find any nests, although we searched carefully. But the prettiest sight here was a colony of Arctic terns, breeding on the gravel spits near our anchorage. Their young were partly feathered, unable to fly. Seeing one of them walking on the shingle, Johannes jumped ashore and put it in his cap, when the parents came at him with piercing cries, and pecked so savagely at his head, that he was glad to hold one hand over it and run for the boat. The birds followed, and hovered within a foot of him, crying piteously as he sat in the boat with the young one. Seven or eight others forming the colony joined in the uproar. Feilden asked Johannes to return the young bird, so he tossed it into the sea. The little creature had eight or nine feet to swim ashore, but it paddled to land as comfortably as a duckling, and scrambled up the gravel. The delight of the old birds was unbounded; they hovered over it, alighted beside it, and pushed it along until they considered it had reached a place of safety.

I went to bed at 2 A.M., rejoicing in the prospect of a fine day coming, for the barometer was rising steadily and the sky looked favourable; but when Curtis turned in at five he said a fog had come up.

August 7.—Kjeldsen called me at 8 A.M., and reported the fog too thick for the ship to leave her anchorage with safety, so I promptly went to sleep again until 11. Although the glass had continued to rise, there was considerable wind from the north-east, and soon after noon the fog gave place to rain. This cleared the air a little, and allowed us to make for the head of the bay; but our troubles were not over yet; the engine broke down, and obliged us to put back under sail. The repairs occupied some hours, and lost us valuable time. At 2.45 P.M. the temperature was 38° on deck, and aneroid 30′ 46″.

Our sailing up and down the bay certainly gave us plenty of opportunity to study its grand proportions, and admire its rugged shores. Judging from the time occupied in steaming up it, we thought the distance was fourteen or fifteen miles from Pachtussoff Island to the glacier at the head. As this fine bay appeared to have no name on the chart, we called it after Pachtussoff's able pilot, "Ziwolka," and the glazier we named the "Ibis" glacier, in memory of our brothers of the British Ornithologists' Union. I think the white piece on our charts, extending overland from Ziwolka Bay to Bear Bay, must be intended to indicate Ibis glacier, and another at the head of the latter bay, as they run in that direction, and could scarcely have been mistaken for frozen sea. The upper part of Ziwolka Bay appeared to be all deep water. At a mile from the glacier there was no bottom at fifty fathoms, and at 250 yards from it we found forty fathoms. To Curtis and myself, who had never seen a large glacier flowing like a great river of ice down into the sea, the sight before us was indeed grand; but Feilden and Kjeldsen say it is small and insignificant compared with some of those on Spitsbergen. Its width at the sea-line was about a mile, and its cliffs of ice stood fifty feet above the water. Plate 65 represents the glacier as seen in the distance. We landed to the east of the glacier on a shore built up of old moraines and other debris. The face of the ice towards the sea showed an endless series of beautiful shades of the clearest blue, but on the east side it had been washed and soaked with glacial mud till it was a dark dull grey brown, almost black in places, and looked far more like water-worn sandstone than ice. Plate 66 represents this side view of the glacier, taken some hundred yards from the sea. The near foreground is the remains of an old moraine, eroded by the present glacier stream, which shows as a thin white line beyond; although it is too deep to wade for a mile and a half above this

PLATE 66



F. 11. 3 *S.* 12.40 *a.m.* 8-8-97.]

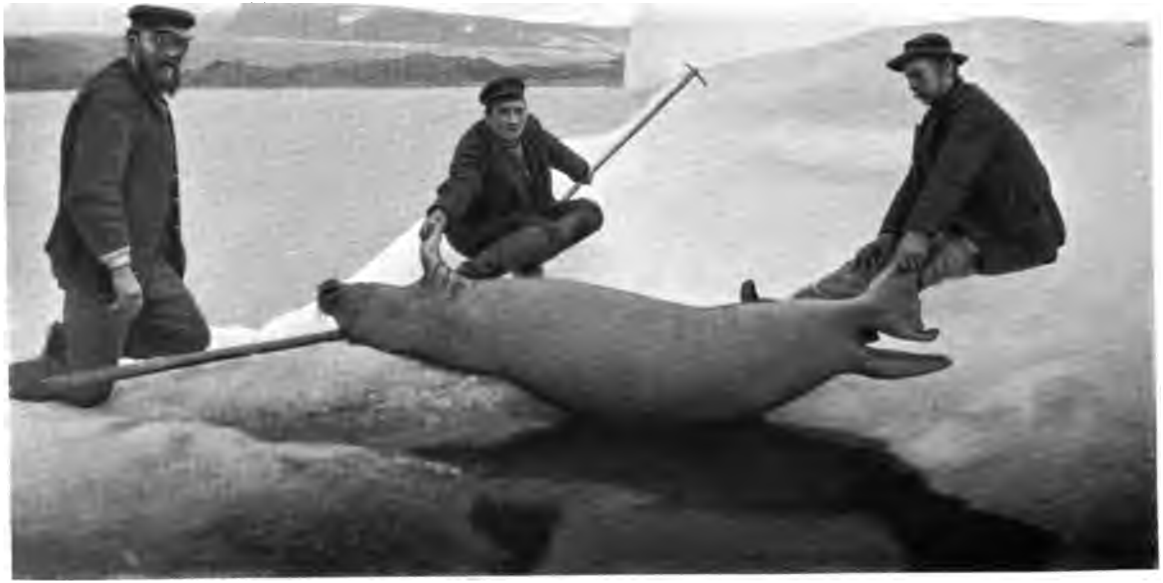
"IBIS" GLACIER, LATERAL MORAINE, AND RIVER.

point. Next is a broad stretch of shingle intersected by many offshoots from the main stream; and then the glacier itself, although the lower parts are so black, they look, as stated above, far more like rocks. It will be noticed that the whiter parts above are much crevassed and contorted. This is the result of the rapid contraction of the glacier during the last part of its course, for at the highest point we reached it was quite three miles wide, and in a distance of only three or four miles this mass had been forced to rearrange itself into a width of one mile.

Feilden, accompanied by Daniel, ascended the hill seen on the left side of Plate 65; while Curtis and I with our men decided for a walk on the glacier itself. Going up the bank of the river, a point was at last found where Hansen and his wading boots could cross; so he carried us over, and we climbed the side of the ice. The first part of the ascent was very steep, but after that was passed, the walking was as good and smooth as on a frozen highroad in England. In Plate 65 a long black line will be seen coming down the glacier and ending on its left side. At the point we struck this central moraine it was a third of the total width from the side we had ascended, but higher up it tended more to the centre. At first it was 100 yards across, and made up of great heaps of stones, some of them rising 30 feet above the glacier. Under the outer crust of these heaps we found the stones to be embedded in solid ice, showing that all water froze directly it sank below the outer surface. As we walked up the glacier this central moraine decreased greatly in size, at times being only a few yards across, and then extending again to 40 and 60 yards in width, but evidently with a lessening average of material as it ascended towards its source. Feilden observed from the high point he reached that this moraine continued up the glacier some ten miles to a large peak protruding through the ice; he could not trace it beyond. And now I have to relate the most wonderful point about this moraine. It contained very little if any mud, and three-quarters of its stones, large and small, were much water-worn. Some of the harder and larger ones were almost perfect balls. I have one lying on my desk as I write, picked up 620 feet above sea-level, which would be accepted as an ancient cannon-ball without a murmur of dissent if it had been discovered near one of our old fortresses. It is only 5 inches in diameter, for we naturally selected those of reasonable size to carry, as we were some miles from the ship; but there were others over a foot in diameter quite as round. This moraine was not in a hollow, where the accumulated waters of the spring thaws rushed down, grinding and rounding the stones in their passage; it was placed on a well-marked ridge of the ice, with considerable hollow on either side. It was therefore clear the stones had not been rounded by water in their short passage from the point where Feilden saw they commenced their journey down the glacier. The only explanation appeared to be, that the remains of some ancient beach was being carried down to the sea, mixed with debris of rocks from the mountain protruding through the glacier. If this solution be correct, that ancient beach was considerably over a thousand feet above the present sea-level.

The Ibis Glacier runs from WNW. to ESE.; on its NNE. are nine hills of considerable altitude, the sides of which have been sheered off by it. From our highest point several mountains could be seen inland rising to a height of 2000 to 3000 feet, but with this exception the whole horizon was ice. Feilden, who reached an elevation of at least 1500 feet, had a far more extended view; and he said on his return that the interior was entirely covered with ice, pierced by mountains with sides too steep to allow the snow to accumulate upon them. From what we saw that night I think there is little doubt that the whole interior of Lütke Land is covered by one great ice-sheet, similar to that enveloping Greenland, but on a much smaller scale.

While we were on the glacier near the highest point reached, an enormous mass of ice "calved" off the foot of the glacier into the sea. We only heard a sound like a roll of thunder, but Feilden saw the whole scene. A long stretch of ice separated from the glacier, and fell forward into the sea; then clouds of spray like steam, rose into the



F. 11. 1/2 S. 3.15 p.m. 8-8-97

SEAL SHOT IN BEAR BAY.

air, and great waves circled off towards the outer bay. Large fragments floated away, some of them the size of cottages; and in half an hour the sea was covered with a great fan of ice blocks, spread out over the whole area within some thousand yards. Cautious old Kjeldsen moved the ship at once to a position nearly a mile farther from such a lively neighbour.

As we were walking over the shingle reaches on our return to the ship, a flock of many hundreds of Eiders passed and repassed several times overhead. They had been sitting on the beach and swimming in the sea near; but rose far out of range, and flew to a height which made it impossible to say which species they belonged to. Although the light during our visit was bad for photography, the rising sun behind the nine cliffs lit up the clouds and gave us some glorious effects of colour as we rowed off to the ship; purple and gold, contrasted with the pure white snowdrifts, the reflected colours from the ice of the glacier, and the deeper tones given by the sea around us.

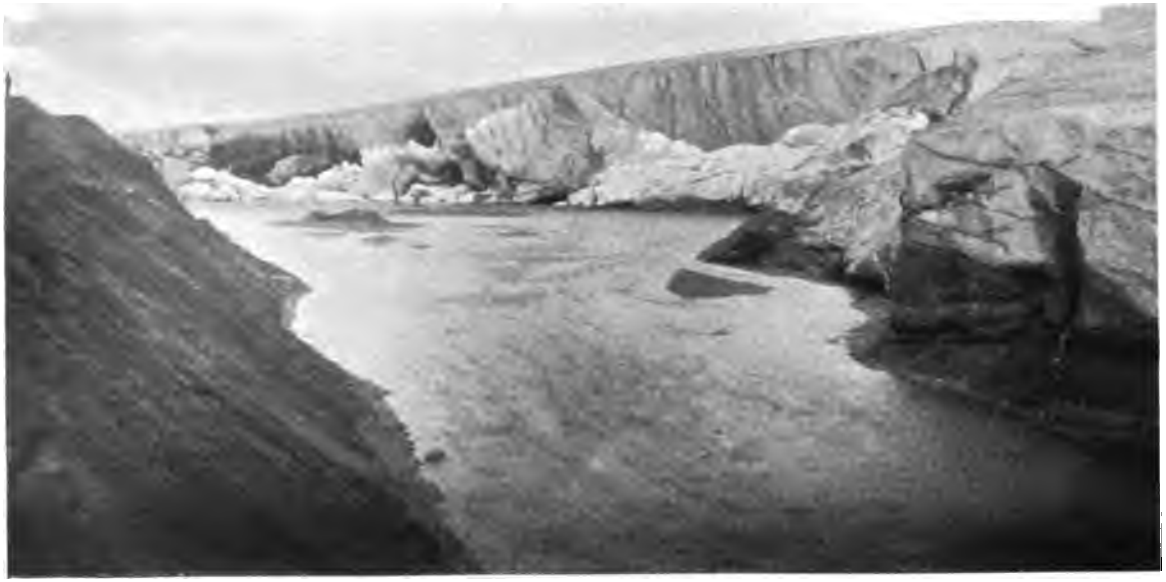
We were back on board at 1.30 A.M., and half-an-hour later the anchor was up and the *Laura's* head turned for "Home." While I felt great regret that the stock of coal and provisions prevented further explorations to the north on this interesting coast, I must confess to considerable pleasure that we were homeward bound at last.

August 8.—During the early hours Kjeldsen had taken the ship from Pachtussoff Island to Bear Bay, and when we turned out she was steaming at half-speed up the bay. This fine inlet measures about twenty miles from its mouth to the glacier at its head, and seems to have deep water in most parts. We passed an iceberg about the middle of the bay which stood 30 feet out of the water and was aground. A cast of the lead close to its side showed thirty-five fathoms, so that the total thickness of the ice was 240 feet. At midday the thermometer in the shade was 44°—in fact, there was no sun all day. Sea-water at surface, 38°; barometer, 30° 50′.

We anchored between the glacier and the shore at 3 P.M. As we pulled to shore a large seal came up two or three yards from the boat, whereon Kjeldsen promptly put a bullet in his throat. It was curious to see the change that came over our men; in an instant they were all eagerness and activity, and as smart in their actions as the best trained crew of an English ship. The seal rose again immediately, under the edge of an ice floe; as soon as he struggled free from it Kjeldsen shot him again, and Hansen caught him with a long hook before he could sink. After considerable trouble they managed to draw him on to the floe, where I photographed the group shown in Plate 67. Kjeldsen is kneeling on the left, in the centre is Harald, and on the right Daniel. Behind Kjeldsen's head may be seen the great glacier, which pours its frozen flood into the head of Bear Bay, flanked on the right by a range of hills. The darker line in front of the glacier is its lateral moraine, rising fifty to sixty feet above sea-level. The seal measured 7 feet 8 inches from snout to tail. Kjeldsen told me afterwards he had shot it through the throat on purpose that the blood might choke it and oblige it to rise to the surface for air; had he killed it at once when out of reach of the hook, the seal would have sunk like a stone before they could have secured it. He tells me there are still from fifty to seventy vessels sailing from the north of Norway alone every year for the purpose of catching seals; and that 800 to 1000 of the large seals, or 1600 to 1800 of the smaller ones, constitute a "full ship." From the little I have seen, I feel sure the number killed but not secured bears a large proportion to the whole, and that the total killed by these ships must amount to 80,000 or 100,000 per annum. If there be added to these the number killed by those vessels sailing from the south of Norway and other countries, what an enormous destruction of seal-life is revealed! It is little to be wondered at that seals and walrus are becoming scarce in these seas.

A number of Ivory Gulls haunted Bear Bay, and gathered quickly on the ice-floe round the carcase of the seal. Among those we shot for specimens, two—both males—had large incubation spots, so they

PLATE 68.



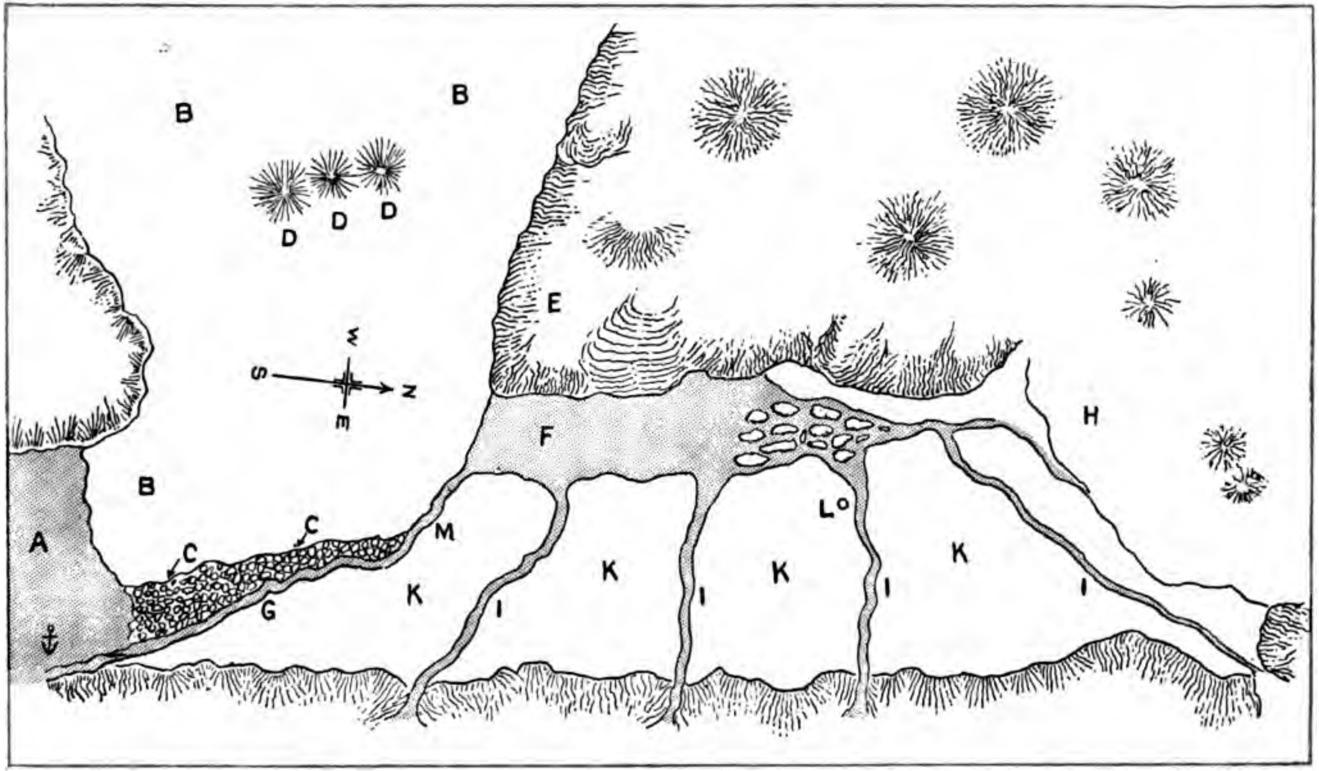
F. 11. 1 S. 6.20 *p.m.* 8-8-97.

BEAR BAY: MORAINE RIVER AND GLACIER.

had doubtless bred in the vicinity; but we failed to find their nesting-places, nor did we see any young birds.

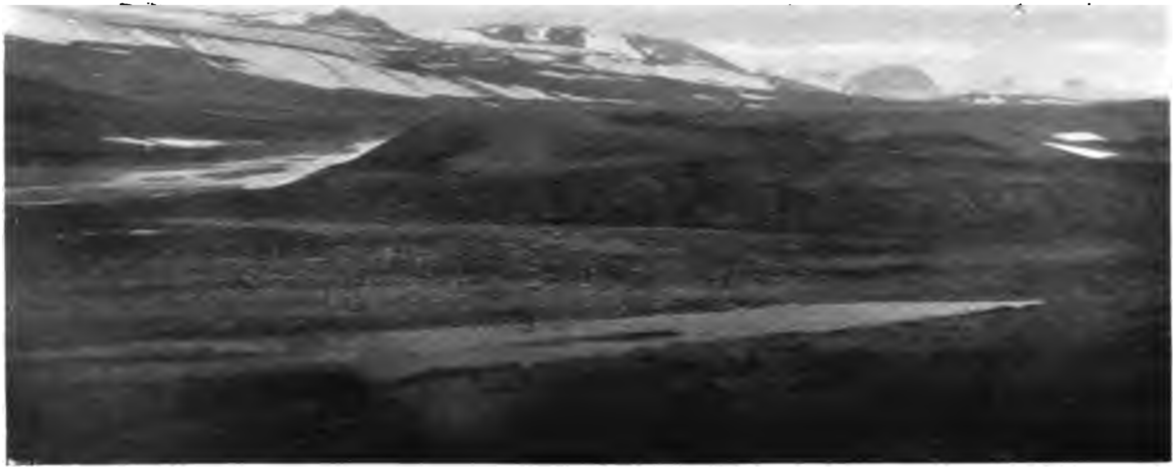
Perhaps the following plan, prepared from a sketch made on the spot, will give a better idea of the country surrounding the head of Bear Bay than a longer description in words alone:—A, The sea, much laden with floating masses of ice, which were constantly calving from the glacier B during our stay, and filled the air with long reverberations like distant thunder as they fell into the sea. B, Bear Bay glacier, flowing down from the interior and pierced at various points by peaks rising through the ice, three of the nearer ones being shown at DDD. C, Lateral moraine, composed chiefly of the debris from the hill E and its extension beyond the sketch. This moraine was of considerable dimensions and most irregular outline; it rose in many places to a height of fifty or sixty feet above sea-level. F was a large lake quite three miles in length, filled up with debris in all its upper part; this debris formed islets between which the stream flowed in many channels. The flank of the glacier B formed an efficient dam to the lake, and its waters ran down to the sea in river G by the side of the recent moraine C. Its chief source of supply was the glacier H, but the streams I I, which brought down the melting snow and ice from the hills forming that side of the valley, also added a considerable quota. We walked up the valley to point L near the head of the lake, and agreed we had come seven miles from the ship; also that the glacier H was still three miles distant, from which it will be seen my sketch is rather out of scale. The valley K K was entirely filled with old moraines, rising in one part to 300 feet above sea-level; and presenting an undulating good firm surface of slate and other rock-debris, covered with a little lichen and a few flowers. It seemed probable that the glacier H had at one time extended down the valley and united with that at B.

There were many tracks of Reindeer, showing that a number of the animals had been in the valley when the ground was soft after the spring thaw; and plenty of cast antlers lay about. One antler had



BEAR BAY GLACIER, LÜTKE LAND

PLATE 69.



F. II. 212 *S.* 7.0 *p.m.* 8-8-97.

BEAR BAY; VIEW UP VALLEY FROM HIGHEST POINT REACHED.

a plough measuring fourteen inches in depth, although it had lost a small piece from one point, so that it must have almost rivalled the pair shown in Plate 14. But no Reindeer were here now. Kjeldsen is the only man on board who has seen any during the whole voyage; he detected four near the shore in the early morning of the 6th, as we were steaming up the east coast of Lütke Land.

More than a hundred Geese were on the lake F when we entered the valley; but we were unable to get near enough to identify them with our glasses, still less to obtain a shot. Several Ringed Plovers were seen and a Purple Sandpiper was shot; but no doubt many of the birds have already taken their departure for the south.

Plate 68 is from a photograph taken at M on plan. On the right is the edge of the glacier B, in the centre the river G, flowing from lake F, and on the left one of the old moraines. Hansen, standing on the extreme left at the edge of the moraine, will give some idea of the dimensions. The camera was placed on another projecting point of the moraine, 80 feet above sea-level.

The next Plate, 69, was taken at the farthest point reached, from another old moraine or gravel heap, 50 feet above the lower ground in front, and 120 feet above sea-level. The glacier H, three miles distant, is faintly shown on the right, with two angular masses of rock protruding through it; the rounded hill to their left—its summit shrouded in cloud—formed the west bank of the glacier H, and another smaller glacier appeared to be coming down the valley on its left. The hills on the left form the side of the valley K; they become steeper as they advance towards the point E. The whole of the centre of picture is filled with moraines or gravel heaps, formerly connected with that on which we stood, before the wide gap—seen in the foreground—was made by the small stream I.

The highest point above sea-level reached was 310 feet. From thence we saw that the whole country above our level was covered with snow wherever the ground was flat enough for it to lie, and every valley contained a glacier coming down from the great white horizon, stretching in all directions as far as the eye could reach, and pierced at intervals by points of rock. As we steamed down the bay on our departure, much more of the interior above the glacier came into view and many other mountain-tops appeared, but the ice and snow still surrounded them on all sides.

We left our anchorage at 11.30 P.M., and reached the entrance of the bay at 3 A.M.

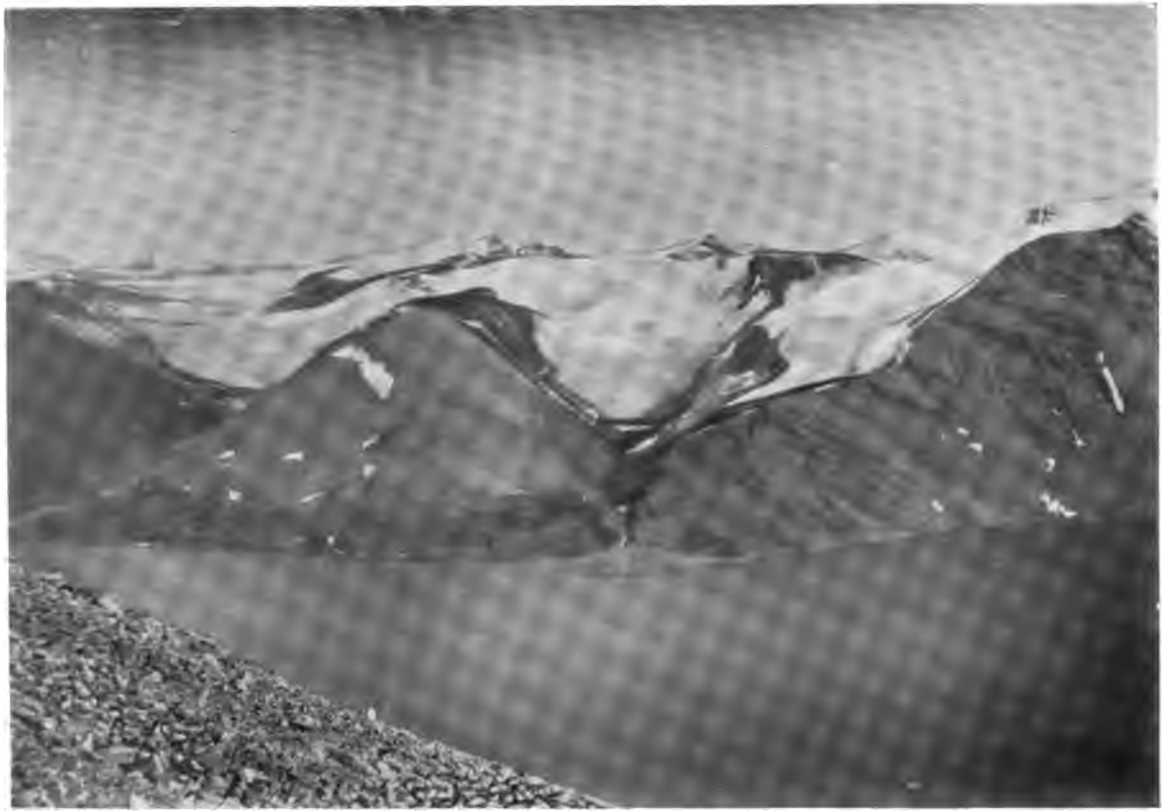
August 9.—We are actually sailing without steam. It was really difficult to believe the fact. This was the third occasion of the phenomenon; the first extending to three hours, the second four hours, and the present one nine hours—a total of sixteen hours between June 4 and August 9. Surely rarely were mortals pursued by such a constant run of bad luck in contrary winds. Whether we sailed east, south, or north, it was always the same, the wind had decided to blow the opposite way that day.

At noon we re-entered Matyushin Shar and took our last look at the Kara Sea. As we sat on deck basking in the sun (temp. 62°), and gazed over the beautiful blue sea gently moving with the breeze that had brought us down, it was indeed hard to realise this was the Kara of history. Our brief stay of four days there will ever be remembered with pleasure. It will probably be very long before others can record a visit under such extraordinary circumstances, or return from Pachtussoff Island without having seen a particle of sea-ice.

We reached Wood Cape at 1.30 P.M., and stopped there half-an-hour to see the remains of the house erected by Rosmyssloff. Enough of the bottom logs remained *in situ* to show us it had consisted of two compartments, as all these old huts appear to have done, the first 12 feet by 19 feet, and the second or inner one 11 feet by 11 feet (outside dimensions). The door faced towards the north-west, and the brick fireplace had been in one corner of the inner room.

Continuing our voyage, we enjoyed a splendid run through the Shar under a clear sky and bright sun. The scenery here is very fine indeed, certainly the grandest to be seen in Novaya Zemlya. Both

PLATE 70.



F. 11. 1´S. 8.15 *p.m.* 9-8-97.

VIEW OF NOVAYA ZEMLYA ACROSS THE MATYUSHIN SHAR.

FROM ELEVATION OF 2000 FEET ON LÜTKE LAND.

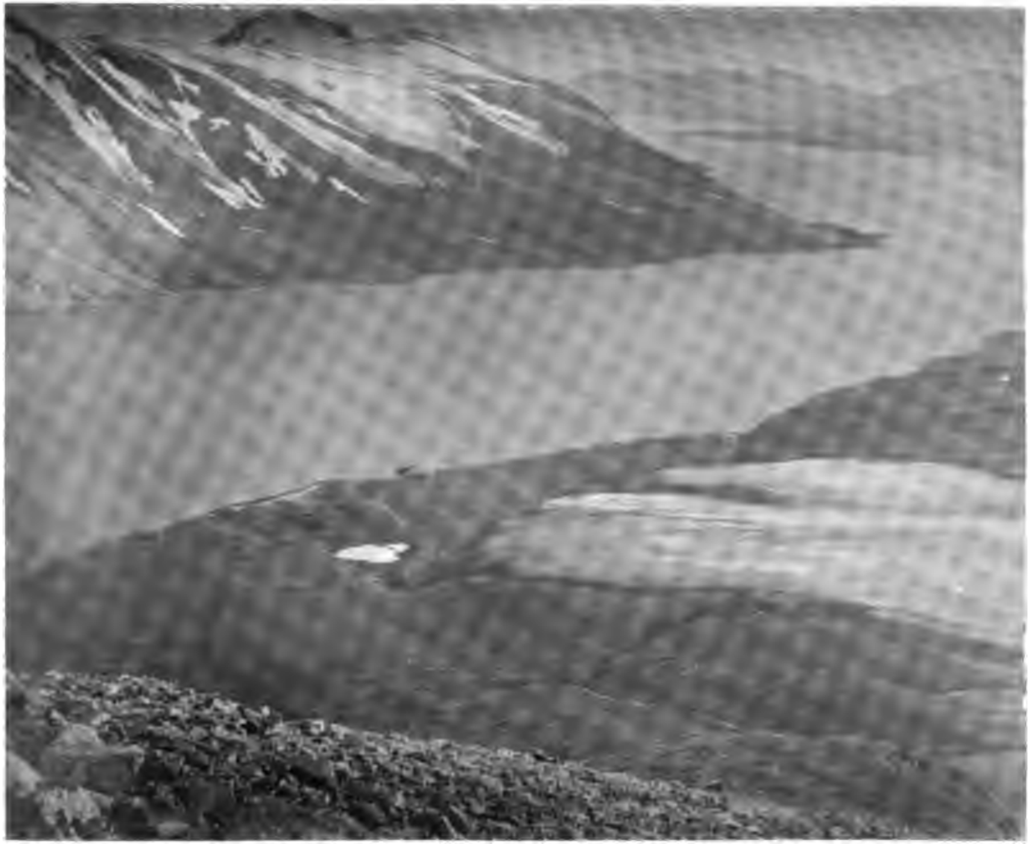
sides of the straits are bordered by mountains rising two to four thousand feet above the sea throughout their entire length, and present a constantly varying scene of rugged grandeur such as only these northern climates produce. I was much struck by the way in which the strata corresponded on the two sides of the Shar, especially in its eastern part. In some places the cliffs showed almost identical lines of rock, although separated by more than a mile of sea; in others, black bands of rock several hundred feet above the water on the north side were confronted by similar rocks near the sea-level on the south. The Shar winds considerably throughout its whole course, so that more than three or four miles can rarely be seen at once; and one often wonders whether any passage can exist through the apparently solid hills ahead. Still there can be no doubt some of the former descriptions have been a little overdrawn, and the Shar cannot be compared in either beauty or magnificence with the best Norwegian fjords. At the north bend of the Shar a glacier (small compared with those we had left) comes down its north side nearly to sea-level. I proposed to Feilden we should land and ascend a hill on its east side, apparently easy of access, as I thought it probable we might get a good view of the interior and of the glacier itself on such a clear day. We landed at 6.30, accompanied by Hansen with the camera, and crossing a large flat area of mud and rocks, began to ascend; but we soon found we were most woefully mistaken, both in the height of the mountain and the ease of the ascent. After climbing up a thousand feet Feilden returned, having only deck shoes on. Hansen and I struggled on, to find the next thousand feet even worse. The whole of that part was covered with loose rocks, from the size of a man's head to that of a large dining-room table, piled up at so steep an angle that many started away at the least touch, and all seemed anxious to continue their journey to a lower level. A little undue pressure would dislodge a rock, and it quickly persuaded a cartload or two to accompany it, so some care was required to avoid joining in the descent. At 8.15 we reached a small piece of solid rock *in situ*, 2000 feet above sea-level.

We were both bathed in perspiration literally, for breast and back of Hansen's linen jacket were wet through; and as the top was still more than a thousand feet above us, I decided it was useless to continue, especially as the light was fading fast. So we set the camera up with all speed and took half-a-dozen photos, most of which suffered from want of light, or exposure, or something. Photographing is very like fishing, there are so many "somethings." Plate 70 represents the view we obtained of the South Island across the Shar; and is interesting not only because it shows how completely the interior of this part of the country is covered with ice and snow, but also from the history of Arctic denudation depicted in the centre.

That little fan of debris on the shore measured nearly half a mile from end to end, and projected some distance into the sea; as the straits are twenty-seven fathoms in the centre here and continue deep close to both shores, a considerable amount of "filling" has been required to raise that fan above the sea-level. Above the fan is the valley from which it came, a gap too large to be filled by the deposit below it, and therefore probably commenced by other agencies before the Shar existed. The valley's upper portion is occupied by a glacier extending for miles into the interior, and draining a considerable basin among the mountains; I do not remember having seen this glacier from the sea, so the 700 or 800 feet between its termination and the sea must be very steep. Down this precipitous funnel rush each spring time the waters of the accumulated winter's snow combined with the early rains, and sweep every loose fragment of stone and mud into the sea below. How trifling are the denuding powers of a temperate clime compared with those shown in this picture; and what an interesting study might be bequeathed to a future generation by an accurate record of all the details of such a spot.

The next Plate, 71, represents the lower part of the glacier and our ship, as seen from the same elevation. The mounds on its side nearest to us are the lateral moraine, composed of mud and stones of all sizes, mixed together, and heaped up in the most irregular

PLATE 71.



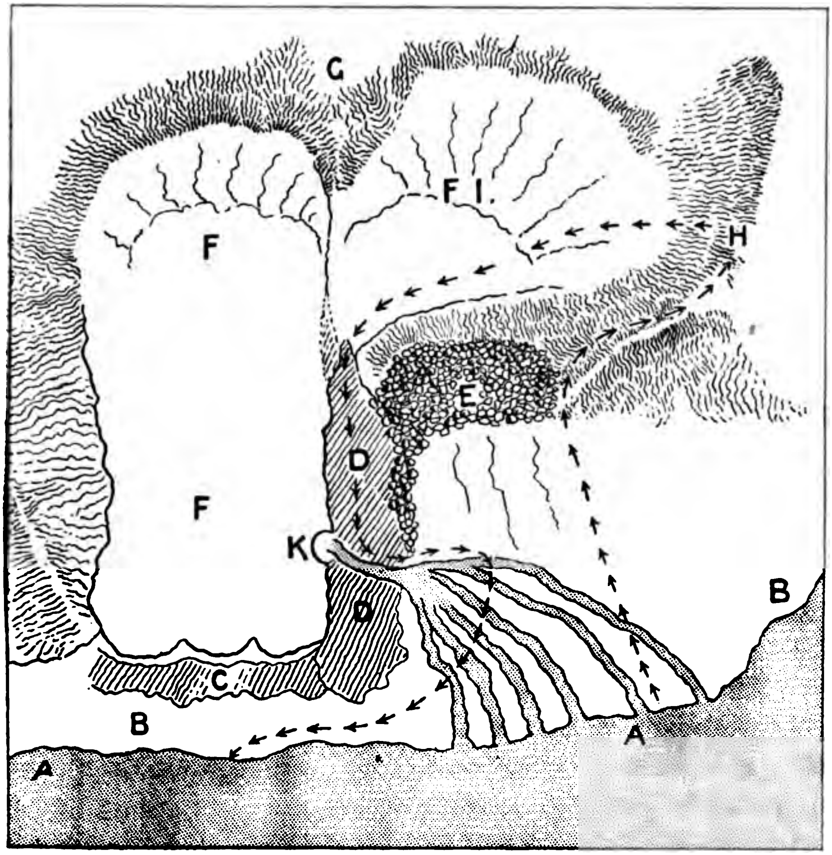
F. 11. 2 1,2 *S.* 8.15 *p.m.* 9-8-97.

LOWER PART OF GLACIER ON NORTH SIDE OF MATYUSHIN SHAR.

AND S.S. "LAURA."

manner, some of the mounds being considerably over a hundred feet high.

The following plan of glacier will make the photos clearer:—A, The sea. B, Broad shingle bank, washed out of moraine and levelled by the sea. C, Terminal moraine. D, Lateral moraine, chiefly composed of rocks and mud from mountain, G. E, A stone heap (free from mud) consisting entirely of large blocks of stone, detached by the winter frosts from mountain, H. It appeared to me that the snow



GLACIER, MATYUOSHIN SHAR.

in winter must fill up the whole of basin, F I, and form a steeply inclined plane from the ridge H to the hill E, over which the stones descended; and only the larger ones had sufficient momentum to reach E. At the time of our visit E was a ridge more than fifty feet above F I, showing the depth to which the snow accumulates in winter. The rock I climbed over from E to H was a fine even-grained stone, varying in colour from sandy yellow to pale grey, and looked as if it would make a capital building stone. G, Mountain, which appeared to be of dark slate, confirmed by the materials composing moraine D. The highest point we reached was at H, and there the photos were taken. The arrows indicate routes up and down. At K there is a large cave in the ice, from which rushes an impetuous torrent with noise enough to make it difficult to hear a man shout a few yards away. The stream at once spreads out into six or eight channels; even when thus divided, some of them reached above our knees. Plate 72 shows in its centre the upper part of glacier F I, a little of mountain H on the right, and a part of mountain G on the left. On consulting the chart after my return, I found that the mountain above H was 3156 feet high. Viewed from the deck through the clear air that day, it did not look a thousand.

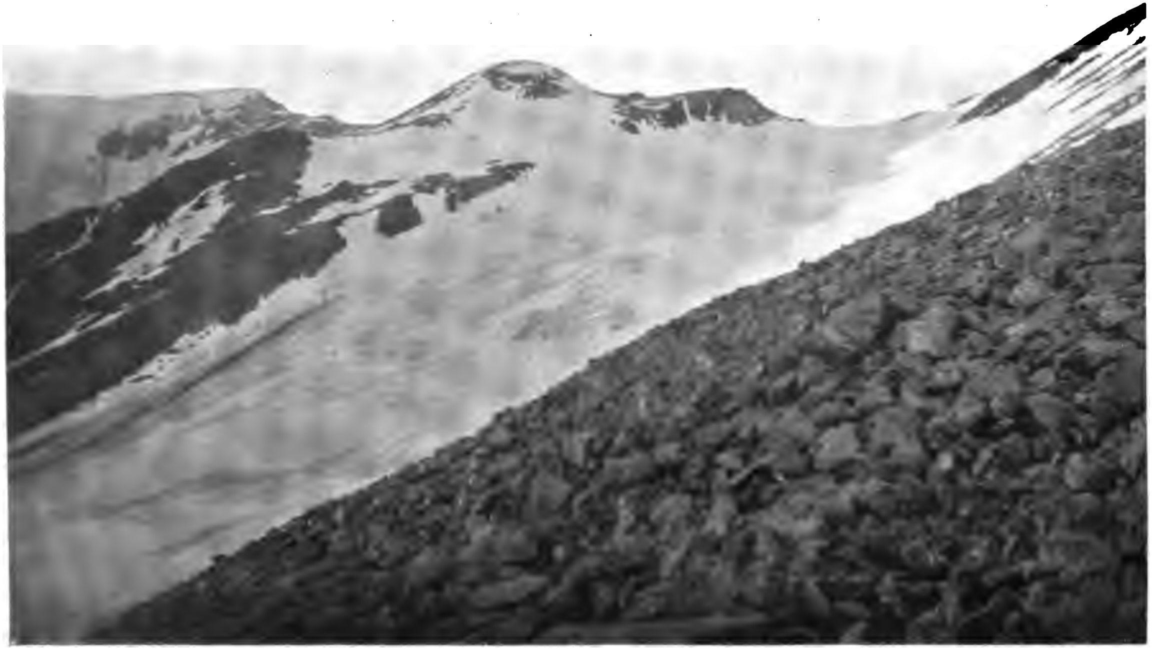
When we regained the shore at 9.40 we found Kjeldsen had run the ship's bow on the shinglé, and was busy taking in water from the glacier stream. No Samoyeds there. There were nearly twelve fathoms under the ship's stern, the shingle bank sloping abruptly as a "tipped" earthwork.

After filling the tanks we steered down to our old anchorage in Pomorsky Bay, and arrived soon after midnight.

August 10.—The next morning being bright, we landed early to get some photographs of the Samoyeds and their houses. I also bought some reindeer skins with beautiful hair, over two inches in length. They have proved regular white elephants ever since, for the hairs persist in shedding themselves over everything.

After lunch we went up the straits in the launch, and landed on

PLATE 72.



9-8-97.

UPPER PART OF GLACIER SHOWN ON PLATE 71.

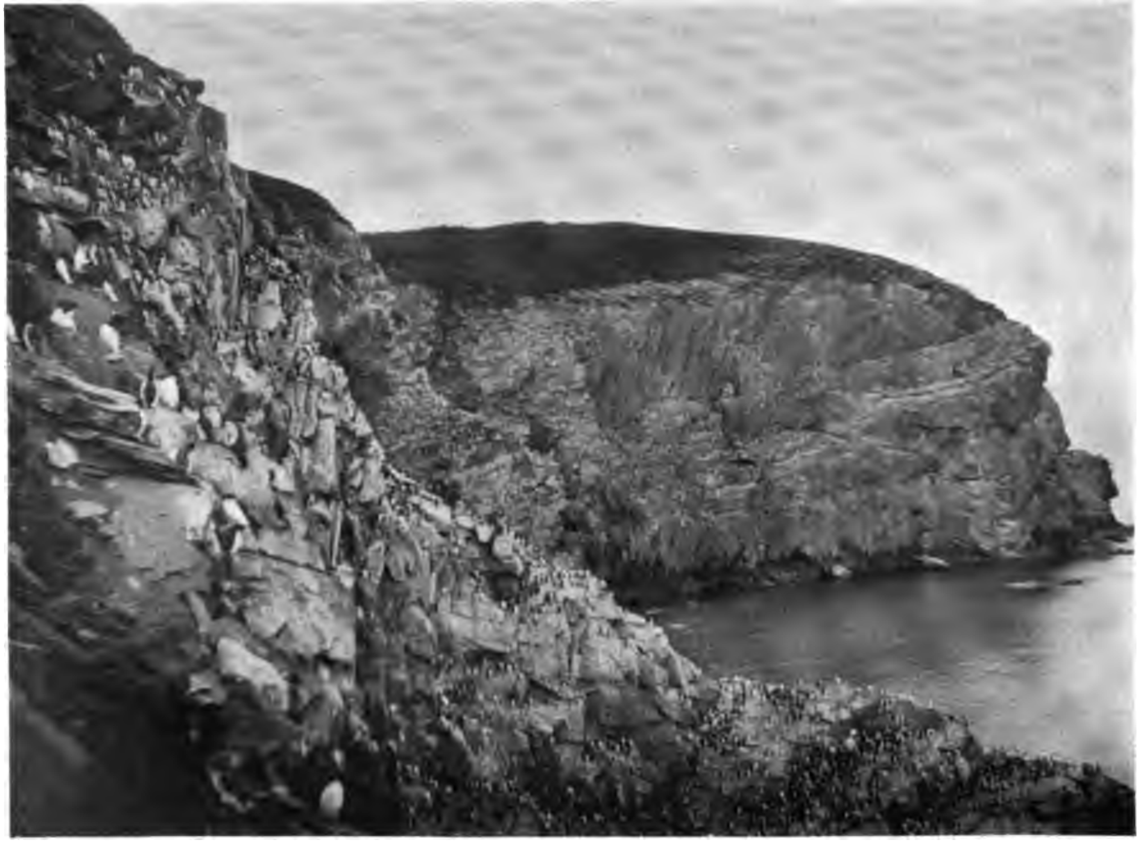
the north side to cross over to Silver Bay; but after two hours' walk we only saw its outer part, all the interior being shut out by Silver Mountain. The lake shown here on Rosenthal's chart must have been caused by the spring thaw. No lake existed at the time of our visit, and its site was only marked by a deeper green of the grass, showing bogs. Our walk was not quite in vain; we had the pleasure of recording the Peregrine on Lütke Land. We heard the birds some time before seeing them, and on reaching the coast we found they had four young ready to fly. The eyrie was placed in a recess, thirty feet down a cliff of rugged slate and seventy feet above the sea. All the young showed down above the feathers on the head. We also saw some Purple Sandpipers and Shore-Larks, and one of the men picked up an egg of the latter, laid away from the nest.

On our return voyage I shot three Bean Geese, which could only fly a little, their wing-feathers not being quite matured after the moult. They were a most acceptable addition to the larder, as our stock of Geese was now getting very low. We passed immense flocks of King-Eider, but they kept carefully out of range. It was midnight when we reached the *Laura*, quite ready for supper. The weather during the last two days has been perfect, continual brilliant sunshine, with scarcely any wind. We could not possibly have enjoyed the fine scenery of the Shar under more favourable circumstances, for the tops of all the mountains were clear the whole time.

This western part of the strait requires careful navigation. We passed some dangerous reefs, extending nearly a mile from the north shore, which are indicated by two or three pieces of rock ten feet above water, but extend considerably beyond the outermost rock visible.

August 11.—We left Pomorsky Bay (Cairn Harbour) at 6.30 A.M., and ran into fog at 9.30, which obliged us to proceed cautiously down the coast, and kept us hove-to outside Nameless Bay till the afternoon. When the fog did at least clear sufficiently for us to proceed, we saw there was a nasty entrance to the bay, as the reefs from the north side came nearly half across, and even on the south side the bottom was visible. After passing the headlands, three hours were spent in looking for an anchorage. This bay is very far from Kjeldsen's idea of "a good anchoration." Its sides are nearly parallel, running east and west, without any bay large enough to shelter a boat, still less a ship; and the two large inlets into which it divides at its east end would not admit our launch. One of these inlets runs towards south-east and the other to north-east. The greater part of the south-east one is made up of shingle banks showing above water; and although the latter appeared a clear expanse of sea, the launch stuck fast in three feet of water at every point we tried three miles from its head. The water in this north-east inlet is thick and milky with glacial mud; it colours the main bay for a considerable distance. Some denuding must have taken place among those mountains to the east to provide material to fill two bays each three miles long and one mile wide. The whole bay is exposed to every storm from any point between south-west and north-west, and in fact only affords a shelter for small vessels when the entrance is protected by ice. Its south side is very distinctly marked by three old beaches or terraces, which are also to be seen on most of the coast in its neighbourhood.

All those who have read Admiral Markham's "A Polar Reconnaissance" will remember his graphic description of the Brünnich's Guillemots in this bay. It had prepared us for a grand sight; but no description can quite bring home to the mind and enable one to fully realise this enormous mass of bird-life. The Loomeries are on the cliffs forming the south side of the bay, and have therefore a north aspect. They extend two to three miles over cliffs rising some two hundred feet above the sea, and every available ledge and cranny throughout the whole of that distance is crowded with Brünnich's Guillemots. Plate 73 (the last I took during the voyage) shows one piece of the cliff. The birds may be distinguished in the foreground from the sea-level to the top; but we could see through our glasses they were even thicker on the more distant rocks, and this



F. 11. 2 S. 3 45 *p.m.* 12-8-97.

LOOMERY AT NAMELESS BAY, NOVAYA ZEMLYA.

picture only shows one small piece of that great cliff face! When a gun was fired, the birds went down to the sea in such dense clouds they seemed to almost hide the water below; yet on turning again to the cliffs, so many remained we hardly missed those which had left. The cliffs were full of young birds in all stages of growth, and many had already joined their parents on the sea below. The smallest of those we caught was well coated with black and white down, the white following almost the same lines as the white feathers in the adult. An army like this residing on one spot for more than three months of each year must require a very bountiful commissariat department in its neighbourhood! and it would be an interesting inquiry to determine what constitutes their chief food supply from the waters near, and why that food is always there in such quantities; for it must be clear at once that an abundance of food to be relied upon every year is an even more important factor in the continuance and growth of these great Loomeries in Novaya Zemlya, Spitsbergen, and Greenland than the suitability of the cliffs for nesting purposes. While we were there, old birds constantly came up from the sea with small fish for their young.

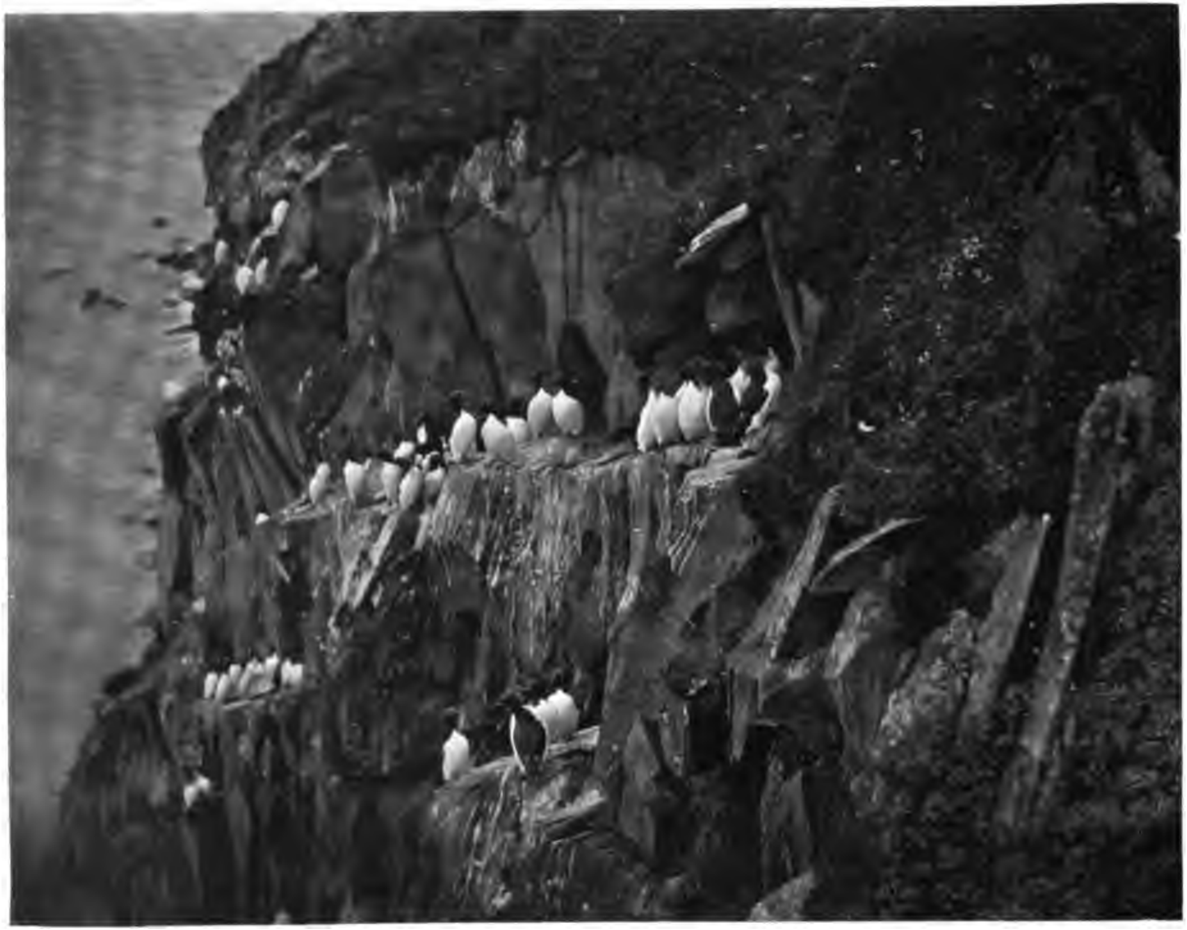
But if the Brünnich's Guillemots levy a heavy toll on the inhabitants of the sea around, they also pay one to others, for the tops of the cliffs were lined with scores of Glaucous Gulls and their young—handsome, well-fed birds, who looked as if they had not a care in life beyond the selection of the fattest youngster from the ledges below. In many places were heaps of Guillemot's eggshells, reminding one of some favourite spot where a thrush had been in the habit of cracking his snail-shells. All the young Glaucous Gulls were feathered, and most of them could fly; but we secured three, after some trouble, though one made his way in a wonderful manner from ledge to ledge down 200 feet, and was only caught by Hansen, who followed him, just on the sea-level. These birds reached England safely, and are still in good health. While we were busy with the birds a fox put his head over the rock above and barked (or rather howled) at us.

Our most prized bird-find here was a pair of Peregrines with young, in a gorge on the same side of the bay as the Loomery. Théel has struck this bird out of his list for all three islands of Novaya Zemlya; but this is evidently a mistake on his part, as we saw the species on each of them. Pelzeln also records it on the South Island.

While crossing the bay, a pair of Divers passed us within thirty yards. All had a clear view of them, and there could be no question their beaks were yellow, so we entered them as *Colymbus adamsi*. These were the only examples seen by us this year, but in 1895 we met with this species twice in Novaya Zemlya, each time watching the bird on the water. When most of the earlier accounts of Novaya Zemlya were written, distinction had not been drawn between *Colymbus glacialis* and *C. adamsi;* the birds were therefore naturally referred to the former species, but from our observations I am inclined to think *C. adamsi* occupies all this district.

We walked for some miles to the south of the bay, and saw a number of cast Reindeer horns, but no signs of the animals having been there lately. There was little of interest in the interior; the life of Nameless Bay centres round its cliffs and shores. While we were away Kjeldsen had shot a number of Brünnich's Guillemots; he evidently has no intention that the men shall be short of food before reaching Vardö. They like the birds, but I class these with Puffins, &c., among things that *can* be eaten, but I would much rather not! The birds seen here were Snow-Buntings (twenty or thirty), Snowy Owls, Peregrines, Pomatorhine Skuas (in the bay), Black Guillemots, Brünnich's Guillemots, Glaucous Gulls, and Yellow-billed Northern Divers; doubtless all the early breeders had left. The men had refixed the canvas over the launch in the afternoon; at 6.30 P.M., August 12th, the anchor was raised and the ship's head put for Vardö, on the direct homeward way. The weather during the last ten days has been beautiful, and indeed our whole voyage has been most favourable, compared with the accounts of others visiting these countries. Kjeldsen tells us that on one occasion fog prevented Count Wilczek from

PLATE 74.



F. 11. 1 *S.* 3 *p.m.* 12-8-97.

BRÜNNICH'S GUILLEMOTS

NAMELESS BAY.

leaving the ship for eight days, and to make his enforced confinement the more trying, Ice-Bears appeared several times on the ice near, but escaped under cover of the mist. We have only suffered from two storms of any severity, that off the North Cape on our outward voyage, and one when safely anchored in Seal Bay.

On the 13th many birds were over the sea all day, including large numbers of Fulmars and Kittiwakes; Skuas were also plentiful, chiefly Pomatorhines. As little coal remained the *Laura* was very light, and she rolled too much for comfort throughout the two following days. Kjeldsen sighted land soon after 7 A.M. on the 16th, but unfortunately it was the mountains to the east of Tana Fjord, and necessitated a long steam back to Vardö. Our skipper could not understand the reason for our having been carried so much out of our course, and thought the only explanation must be some currents from the White Sea. The same thing occurred in 1895, when the *Saxon* returned from Kolguev for coal.

It was 3 P.M. when we at last dropped anchor in Vardö Harbour. On reaching the British Consul's office we found the place as silent as if the hour was 3 A.M. instead of P.M., and a notice on the door to say that it was closed till five. This was unbearable with all our letters inside, and we did not rest until we had successfully disturbed Herr Holmboe's after-dinner nap. His most important news was that Andrée had started from Danes Island, Spitsbergen, on July 11th, in his balloon, for the North Pole, and that the *Windward* with the Harmsworth Expedition was expected every day; in fact, the *Laura* had been mistaken for her.

We left again at 8 P.M. Norske time, and at 7 P.M. the next day reached Honningsvaad, where we put in to despatch some telegrams and letters. As we steamed out of the harbour a wonderful picture of the sea life of the Arctic was presented; immense shoals of saithe—a black-backed fish something like a cod—were playing on the surface of the water and feeding on some small fish; above them were thousands of Kittiwakes uttering their shrill cries and sweeping over the surface of the sea in all directions in chase of the small fry, who were leaping out of the water to escape the saithe. Scores of the large immature Gulls—probably Greater Black-backs—joined in the feast provided, but more sedately, most of them swimming and catching the fish as they passed. One or two small whales constantly appeared on the surface; and the lords of creation were present in sixteen boats to take their tithe of the saithe with nets and other appliances. It was one of the most interesting sights I have ever enjoyed.

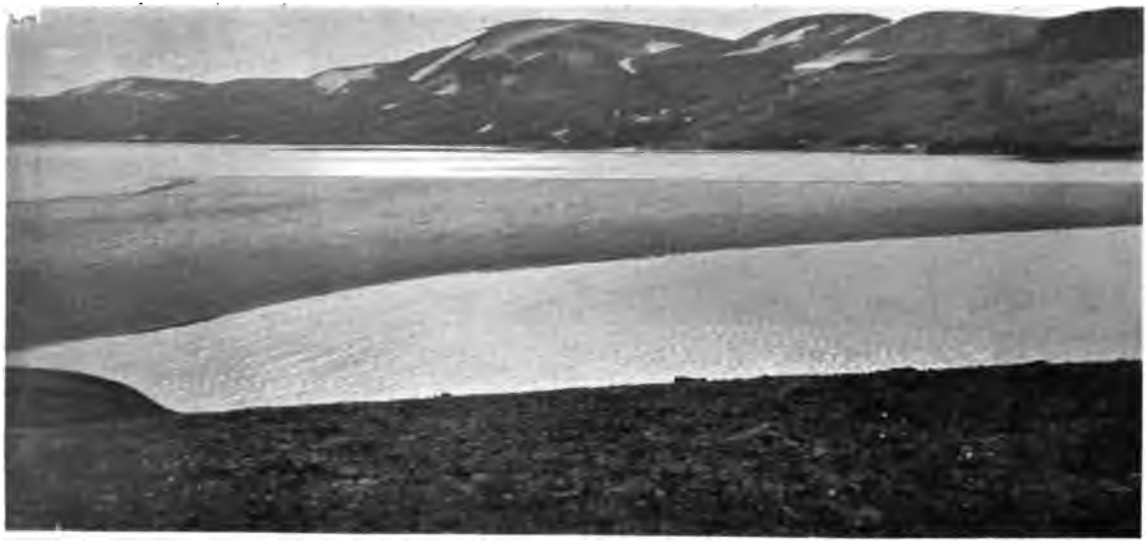
We made a slight detour and steamed through Lyngen Fjord, as my companions had not previously seen its magnificent scenery, some of the finest in the north of Norway; but unfortunately the upper part of the mountains and glaciers were shrouded in mist. I had passed through this Fjord in 1896, when all the tops of the mountains were coloured a lovely crimson by the rays of the midnight sun.

On the 20th we steamed into Tromsö Harbour; and I had the pleasure of handing over the *Laura* with her crew, launch and gear to Herr Giæver in sound condition. I believe he was most pleased to see the launch again, as the one thing he parted from in June with least hope of her safe return; and when I look back at all the vicissitudes she went through during those months, I often wonder how she ever managed to escape the perils of the voyage. We reached Tromsö with coal for two days left on board; not enough to have rounded the north of Barents Land with.

And now the time had come when we must say good-bye to Kjeldsen and our crew, quite a pathetic parting with most of them! And right good men they had proved themselves, honest, willing, and capable.

I have read rather severe remarks in more than one book of travel on the Norwegian sailor, and they were no doubt fully justified by the men the authors had to deal with. I think the explanation is this. These seamen have been engaged in Tromsö and other northern parts of Norway in the early summer, when all the best men had gone months before, and only those remained with some weak spot in

PLATE 75.



F. 11. 1/5 *S.* 10.45 *p.m.* 12-8-97.

NAMELESS BAY VIEW TO SOUTH-EAST.

their character which caused them to be declined by the local captains. We started under much more favourable circumstances, as Kjeldsen, who knew every man in Tromsö well, had engaged the men he thought most suitable during the previous winter. I never wish or hope to sail with a better crew.

The last adieus said, we started south in the *Erling Jarl* on the 22nd, and after a pleasant voyage down the Norwegian coast reached Bergen on the 27th. There we joined the *Eldorado*, and, favoured by splendid weather in the North Sea, by 7 A.M. of August 30th we were once more in England.

Our voyage of eleven weeks might be considered unsuccessful, inasmuch as we never reached the country which we intended to visit; but the time was occupied with interesting work on Waïgatch, Dolgoi Island, and Novaya Zemlya, and some few additions were made to the facts already recorded respecting their ornithology, botany, and geology.

The Great Tundra or Bolshaia Zemelskija country, lying between the Petchora and Karataikha rivers, yet remains an unknown land, as far as its bird-life during the summer season is concerned; and I believe investigation will show it to be one of the most interesting ornithological districts among the few which still await exploration in the Western Palæarctic region.

We have proved that it is inaccessible by sea, but the land route has not yet been attempted. Should this be undertaken, a supply of provisions could be forwarded the previous year by a trading steamer from England to Archangel, and sent on to Pustozersk by the local steamer which plies three or four times each summer. Little dependence can be placed on any local food-supply, beyond tame reindeer, for which the Samoyeds asked twenty roubles each at Habarova in 1897.

Perhaps the best position for summer quarters would be the northern slope of Mount Inty, on the east side of the Khapidira River, as it is the nearest high land to the sea, and the mosquitoes are probably less troublesome there. Excursions could be made to the lakes and marshes on the west, and to the Karataikha River. No doubt considerable difficulties would attend such an expedition, but these generally constitute additional charms for an Englishman; and I trust that before long we may hear from one of our countrymen some account of bird-life in this region.

APPENDIX

APPENDIX A

CONTRIBUTION TO THE FLORA OF RUSSIAN LAPLAND.

By Colonel H. W. Feilden.

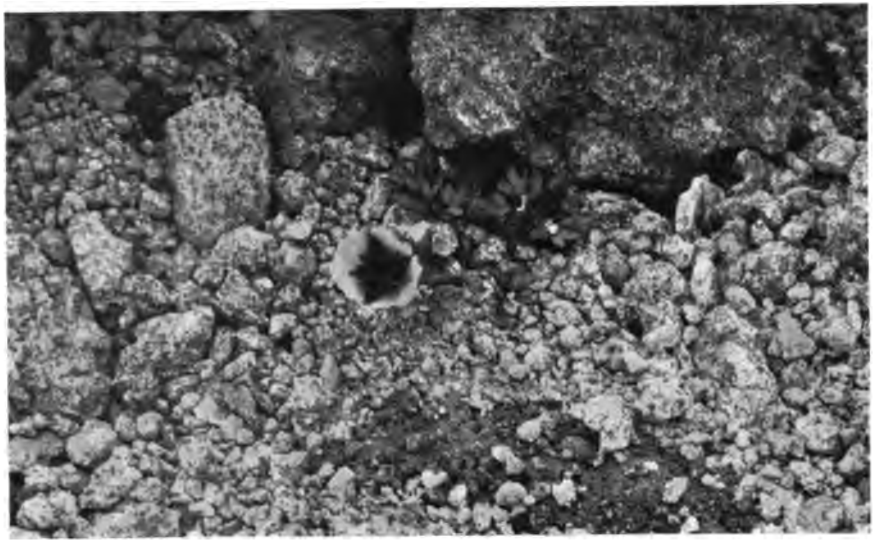
The beacon on Sviatoi Nos is in lat. 68° 9′ 50″ north and long. 39° 47′ 40″ east of Greenwich. The neighbouring Ukanskoe River flows from a lake of the same name into the south-west angle of Sviatonoskaia Bay, between the high, steep, dark bluff Tolstoi and the small islet of Ust Vokanski, where it is about half a mile in width. There are five fathoms depth at the entrance, and not less than two and a half fathoms are found for two miles up the river, which affords safe navigation for vessels drawing fifteen feet. At three and a half miles up, the rapids commence, and it is no farther navigable, even for small boats. From the mouth of the river to the rapids it is more correctly speaking a fjord, flanked on either side by the granite and gneissoid-granite rock formations, which are the prevailing ones in this area. The right bank of the river is the steeper, the granite slope rising to a height of 200 to 300 feet before it attains to the level of the tundra land. This slope is clad with coppice-wood rising to a height of twelve to fifteen feet, and is chiefly composed of Birch, *Betula intermedia*, and Willows, *Salix lanata* with *S. phylicifolia*. *Betula nana* is very plentiful, but nowhere larger than a shrub; *Pyrus aucuparia* and *Juniperus communis* are intermixed; but the predominant feature of the woods is Birch. The undergrowth is chiefly *Empetrum nigrum*, *Vaccinium*, Mosses, Lichens, and plants of various kinds which generally hide the rock surface. As we look up the Ukanskoe to the south, it appears beyond the rapids as a brawling river, not unlike one of our Scottish Highland streams. The banks are edged with high accumulations of immense boulders, which are also spread broadcast over the shallow river-course, the clear water rushing and foaming between them. Nowhere is the vegetation very profuse along the river-course, but several species of *Viola* showed, with *Gnaphalium dioicum* and *Pedicularis sudetica*, here and there *Taraxacum dens-leonis*, *Sedum rhodiola*, *Lychnis alpina*, and *Phyllodoce cærulea*. Looking closely, we meet with *Trientalis europæa*, and *Bartsia alpina* is not uncommon. In the dells leading from the river to the upland, vegetation is richer, gurgling rills trickle down most of them, and the Birch woods screen the flowers from the bitter winds, which come on so suddenly that in a few minutes there may be a change from what seemed tropical heat, with myriads of mosquitoes in attendance, to a temperature at the freezing-point, and the disappearance of one's tormentors. In these sheltered gullies and on the slopes *Anthriscus sylvestris* grows abundantly, but from the water's edge to an elevation of 150 feet *Veratrum lobelianum* is the representative plant. Yellow-blossomed *Trollius europaeus* waved all around. This flower proved a valuable aid in collecting insects; when a sudden change took place in the temperature the Globe-flower closed its petals into a tight ball, but not before the flies, diptera, beetles, and many other species of insects had fled for refuge to these sheltering bowers. *Myosotis sylvatica* and *M. palustris* grew by the edges of the rills, with *Nardosmia frigida*, *Saussurea alpina*, *Archangelica officinalis*, *Cornus suecica*, and *Adoxa moschatellina*. *Geranium sylvaticum* was common enough, but was hardly in flower, and the same with *Cardamine pratensis* at the time of our visit, whilst *Caltha palustris* brightened the rivulets with a border of yellow, as did *Ranunculus acris* on the drier knolls.

On ascending to the uplands from the valley of the Ukanskoe River, a height of 300 feet or so, we see stretching around us not an absolutely flat country, but a sombre, grey, monotonous, dreary expanse of ice-worn land. There are undulations and swellings, the former in many places occupied by lakes and tarns, and by broad surfaces of Lichen-covered peat, with patches of *Eriophorum*. We find in some places still deeper hollows concealing lakes or fair-sized sheets of water, and around these are grouped Birch woods, and the same may be seen in a few sheltered dells; but as the eye travels far and wide over this sad-looking land, these favoured localities are generally hidden from view, and the grey slopes and ice-abraded surfaces predominate. The entire country is covered with erratic boulders, all clad in shaggy coats of Lichen-growth.

These boulders are spread far and wide in countless thousands, scattered over the tops of the rounded eminences, which do not rise higher than 500 to 600 feet. They accumulate in far greater numbers in the hollows and undulations of the rock surface. It is difficult to walk over them, as progression is a series of leaps and bounds, with the danger of falling into the yawning gaps between the boulders. Some of them are of great size, and in places they take most singular positions. One can easily conjure up the impression that you see around altars and monoliths, and the work of some departed race of Titans, and this adds to the weird feeling of a solitary ramble in that dreary land.

Except by the borders of lakes, or in some of the undulations of the land where there are accumulations of peat, little or no humus rests on the surface of

PLATE 76.



F. 64. 25 *S.* 5.30 *p.m.* 20-6-97

RANUNCULUS GLACIALIS

HONNINGSVAAG, 1050 FT. ABOVE SEA. NORWAY.

this glaciated country. The flora, however, is richer than one might expect from the surroundings. The lovely little *Diapensia lapponica* with its bosses of white bloom grows everywhere on the bleakest and most exposed situations, where apparently only a few grains of earth and triturated rock hold its roots together. *Ledum palustre*, growing as a small bush in damp spots and on peaty soil, is one of the most striking plants of the tundra. *Arctostaphylos alpina*, *Vaccinium vitis-idæa*, *V. myrtillus*, *Calluna vulgaris*, this last rarely, with *Phyllodoce cærulea*, *Andromeda polifolia*, conspicuous by its pink, waxen blossoms; *Loiseleuria procumbens*, and *Empetrum nigrum* are a representative group of the tundra plants.

In one or two of the dells on the tundra where we met with a thick layer of peaty soil *Pinguicula alpina* was found, but it is not widespread. The Saxifrages are represented by two species. *S. cæspitosa* was growing on the small gneissoid islands at the mouth of the Ukanskoe, and *S. nivalis* in the ravines of the tributary streams of the main river. Four species of *Papilionaceæ* are common on the barer parts of the tundra; their hard, strong, tap-roots work into cracks and crannies of the rock. These are *Astragalus alpinus*, *Phaca frigida*, *Oxytropus sordida*, and *Hedysarum obscurum*. Of the Rosaceæ, very beautiful is *Rubus arcticus*; *Rubus chamæmorus* is dotted over all the damp peat lands; *Rubus saxatilis* is not uncommon in the Birch woods amongst boulders. *Geum rivale* and *Potentilla comarum* are scarce, whilst *Alchemilla vulgaris* var. *alpestris* is abundant amongst the boulders of the river-side. The only *Draba* I met with was *D. incana*.

The plants collected in June 1895 in the vicinity of the Ukanskoe River were ninety-six in number:—

Ranunculus acris var. *pumilus* Whlb.
Trollius europæus L.
Caltha palustris L.
Draba incana L.
Cardamine pratensis L.
Viola canina var. *montana* L.
  ,, sylvatica Fr.
  ,, stagnina Kit.
  ,, epipsila Ledeb.
  ,, biflora L.
Lychnis alpina L.
Cerastium alpinum L.
Geranium sylvaticum L.
Phaca frigida Rich.
Astragalus alpinus L.
Oxytropis sordida Willd.
Hedysarum obscurum L.
Alchemilla vulgaris var. *alpestris* Schmidt.
Potentilla comarum Nestl.
Geum rivale L.
Rubus saxatilis L.
  ,, chamæmorus L.
  ,, arcticus L.

Pyrus aucuparia Goertn.
Saxifraga cæspitosa L.
„ nivalis L.
Sedum rhodiola D. C.
Myriophyllum alterniflorum D. C.
Anthriscus sylvestris L.
Archangelica officinalis Hoppe.
Cornus suecica L.
Adoxa moschatellina L.
Galium sp. possibly *G. trifidum* L.
Artemisia sp.
Pyrethrum bipinnatum Willd.
Saussurea alpina D. C.
Gnaphalium dioicum L.
Taraxacum dens-leonis Des.
Nardosmia frigida Hook.
Ledum palustre L.
Arctostaphylos alpina Spr.
Andromeda polifolia L.
Calluna vulgaris Salis.
Phyllodoce cærulea Bab.
Loiseleuria procumbens Desv.
Pyrola minor Sw.
Vaccinium vitis-idæa L.
„ myrtillus L.
Diapensia lapponica L.
Trientalis europæa L.
Myosotis palustris Rel.
„ sylvatica Hoffm.
Veronica *sp. sine flore.*
Bartsia alpina L.
Pedicularis sudetica L.
„ lapponica L.
Pinguicula alpina L.
Polygonum viviparum L.
Oxyria digyna Hill.
Betula intermedia Thomas.
„ nana L.
Salix phylicifolia L.
„ lanata L.
„ laponnum L.
„ serpyllacea Willd.
Empetrum nigrum L.
Juniperus communis L.
Allium schœnoprasum L.
Veratrum lobelianum.
Luzula multiflora Lej.
„ confusa (*hyperborea*).
„ Wahlenbergii Rupr.
Scirpus cœspitosus L.
Eriophorum angustifolium Roth.
„ vaginatum L.
„ scheuchzeri Hoppe, *capitatum* Host.
Carex halophila F. Nyl.
„ aquatilis Whlb.
„ vaginata Tausch.
„ glareosa Ley.
„ rariflora Sm.
„ ampullacea f. *planifolia* Norman.
„ salina var. *flavescens* F. Nyl.
„ rigida Good.
Anthoxanthum odoratum L.
Hierochloe borealis (*odorata* Vahl).
„ alpina L.
Poa pratensis L.
Lycopodium annotinum L.
„ alpinum L.
„ selago L.
Equisetum arvense L.
„ pratense Ehr.
„ sylvaticum L.
Lastrea spinulosa Presl.
Polypodium dryopteris L.

APPENDIX B

A CONTRIBUTION TO THE FLORA OF KOLGUEV.

BY COLONEL H. W. FEILDEN.

THE island of Kolguev lies between 68° 43′ and 69° 30′ north lat., and long. 48° 15′ to 49° 55′ east of Greenwich. It is about fifty geographical miles in length, and some forty in width. It possesses no harbour for a sea-going craft drawing any depth of water, and none of its rivers are navigable. It is surrounded by shoals and sandbanks, and often during summer by ice. In winter it is completely ice-bound, and indeed during the whole year the ice seems to remain on its eastern shore. Its western coast during the short summer is freer, but even in the month of July 1895, when I passed ten days on that side of the island, the ice-pack came down from the northward, and for three days enveloped the coast. The climatic conditions of Kolguev are very severe. Professor Saweljew, who with Dr. Ruprecht (conservator of the Botanical Museum of the Imperial Academy of Science, Russia) visited Kolguev in 1841, makes the following remarks about the climate: "During the sixteen days which we spent at various spots on (or off) the island in July and August, the thermometer never rose above 9° R., and even this but once, at mid-day. Usually it stood at 4° or 5°, and fell at times to 2°, or even to 1° R.; while before this, on Kanin (*i.e.* on the mainland), a warmth of 10° to 12° prevailed, which, immediately after our departure from Kanin, mounted (there) to 15° R. It is to be remarked that the soil of this island . . . . does not thaw in the course of the year more than two feet deep. Farther down all remains in a frozen state—a thing which we have not found to occur either on the Kanin peninsula or on the coast of Timan."[1]

Mr. A. Trevor-Battye, who paid an adventurous visit to Kolguev in 1894, has told his experiences in a delightful volume, "Ice-bound on Kolguev."[2] He informs us "that the Russians have a great dread of being compelled to pass the winter on Kolguev. They told him that only one Russian to their knowledge had ever done so. He described the winter as terribly severe; and the Samoyeds all agreed in saying that it was far worse than on the mainland." Mr. Trevor-Battye gives the following as the result of his meteorological observations: "The average shade temperatures for the twenty-four hours during June were, max. 40° F., min. 33° F., the thermometer twice falling to 31° F., and twice rising to 50° F. On June 24th it registered in the sun at mid-day 62° F. The average for July was decidedly higher, though more than once it fell to freezing-point. On August 28th, my thermometer was broken during a gale, but up to that date it varied from 42° F. at noon to 76° F. This, the highest reading, was on August 16th, and on that day it was 86° F. in the sun. The thermometer never fell below 42° F. during August up to the 28th. After this the weather got rapidly colder, and by September 16th the ground was covered with snow, and the lakes were beginning to freeze. Kolguev is exceedingly subject to fogs and gales of great duration. The prevailing wind is northerly, either N., NE., or NW."[1]

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[1] Archiv für Wissenschaftliche Kunde von Russland, 1852, A. Erman, x. 313–316.

[2] "Ice-bound on Kolguev" (London, 1895).

The experiences of Mr. Pearson's party were quite as unfavourable. July 5th, the day on which we landed near the mouth of the Gobista River, was warm and oppressive, with heavy rain showers; the wind from the south and south-west, and accompanied by thunder and lightning. The next day the wind shifted to the north and north-west, with fog and intermittent snow-showers, remaining bitterly cold till the 16th July, when we left the island.

During the whole of our stay, the temperature seldom rose above 35° F., whilst at times it fell to 32° F. Several experiments were made by me to test the heat of the earth at the root of plants in flower. At a depth of five to six inches below the surface, it was found that the temperature varied but little. Several readings of the thermometer taken on different days worked out to 40° F., the observations on no occasion showing a difference of more than one degree. Though these observations on earth temperature in Kolguev are of a perfunctory nature, yet they may be compared with those of our own country. At the Royal Botanic Society Gardens in London for 1895, we find that the mean temperature of the earth at six inches below the surface, during the months of March and November, approximate very closely with the earth temperature of Kolguev at the same depth in July.

I have referred to the subject of earth temperature at the roots of flowering plants more as a suggestion that fuller experiments be made on this interesting subject in frozen regions. It is evident that some species of plants can survive intense cold. For instance, at Floeberg Beach in Grinnell Land, where 70° below zero of Fahr. was recorded and 40° to 50° below zero was a common winter temperature, some twenty-nine or thirty flowering plants exist. A covering mantle of snow as a protection does not seem to be necessary, for I observed there that the pink mountain Saxifrage, *S. oppositifolia,* growing on bare spots, entirely denuded of snow throughout the winter, blossomed luxuriantly on the return of summer. Under such circumstances the roots as well as the leaves of these plants must be completely frozen during the winter; it would therefore be interesting to learn at what temperature the revivifying process takes effect. We all know how rapidly a dark surface absorbs the heat rays, and judging by the crude observations recorded from Kolguev, it is probable that in the Polar regions, the earth exposed to the sun's heat may for some inches retain a temperature sufficiently high to enable the plant to fulfil its function of flowering, though the atmospheric temperature be much below freezing.

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[1] Trevor-Battye, *op. cit.* pp. 445-446.

The geological structure of Kolguev is of special interest, when taken into consideration with the flora. The island is composed entirely of sedimentary beds of glacio-marine origin, without any bottom or basement rock, of an older series, showing throughout its entire extent. Its geology has been described by Mr. Trevor-Battye,[1] and also by myself,[2] and our determinations of its structure coincide with the map of the Russian Geological Survey, on which Kolguev is laid down as consisting of "marine boreal beds." Though the distance of the island from the nearest part of the mainland of Russia is only fifty miles, and the soundings between are under thirty fathoms, yet the evidence is entirely opposed to Kolguev having been connected with the Continent since its elevation above the sea. The present Kolguev is doubtless a part of what has lately been the bottom of Barents Sea, and probably fairly represents the floor of the ocean for a considerable area around. The recent emergence of Kolguev gives to its flora an interest which otherwise it might not possess. As there is no evidence throughout the entire length and breadth of the island of any older rock formation showing through its glacio-marine beds, which might have been the mother-earth of some of the plants now growing there, we are entitled to assume that its present flora is derived entirely from immigration, and that within a comparatively recent period. That the transport of plants or their seeds may readily be effected by floating ice, cannot be doubted by those who have noticed the large quantities of earth and debris resting on the ice-floes which float in summer from the White Sea and the estuary of the Petchora River, into Barents Sea. This ice-pack drifts around, and is at the present day pushed up on the shores of Kolguev; and a similar process must have been going on since the period when the island first commenced to emerge as a sandbank from the sea.

It is, therefore, only what we might expect to find, that the flora shows close affinity with that of the mainland. Probably birds have contributed as well to the transportation of seeds, and it may not be out of place to mention that three species of fresh-water Mollusca were found in the swamps of the Gobista valley:

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[1] *Op. cit.* pp. 392, 395.

[2] Feilden, Q. J. G. S. Lond. 1896, pp. 52–65.

Planorbis borealis, Loven.
Limnæa palustris, Muller, var. *terebra*.
„ *ovata*, Draparnaud, var. *kolguevensis*, E. A. Smith.

This fog-environed, wind-tormented island of Kolguev is exceptionally dreary and desolate-looking. There is not one redeeming feature in its scenery. No mountains, no brawling streams, no woods, no rocky cliffs to ennoble the view. The entire western side of Kolguev, from the mouth of the Gusina River to that of the Gobista, is a long straight line of bluff running nearly due north and south. At intervals, ravines and gullies made by streams issuing from the interior break the coast-line. These bluffs rise to a height of about a hundred feet at the north-west end of the island, but the beds of which they are composed sink by an almost imperceptible dip from north to south, until at the mouth of the Gobista they are not more than forty feet above sea-level; and this dip continues in the same direction, for at the mouth of the Kriva River the land almost merges with the sea, the coast-line being only a few feet above the sea-level.

The aspect of the interior of the island is not more inviting, the brown, sad-looking tundra, patched here and there with snow, and dotted over with shallow meres and lakes, stretches a dreary flat, mile upon mile, embracing the south end, or about one-third of the area of the island. The northern part of the island is more elevated; and from the west coast the land is to be seen rising to the north and north-east, and culminating in rounded hills, which reach an altitude of 200 to 250 feet. An interesting description of this elevated part of the island is given by Mr. Trevor-Battye.[1]

Walking over the tundra in Kolguev is weary work. When the sun comes out from behind the clouds or fog, and there is a definite rise in the temperature, the traveller is assailed by myriads of mosquitoes. The constant stepping from one Lichen-covered peat-mound to the next, in order to clear the *sphagnum*-covered swamps, is exhausting. There is no change in the view; the horizon, bounded by the level tundra, is always the same. The flora is uninteresting. One gets tired of seeing the swamps covered with the white blossoms of the Cloudberry with fluffy-headed *Nardosmia frigida* interspersed. Now and again one passes a red or yellow Louse-wort (*Pedicularis*), and, looking more closely, *Saxifraga*

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[1] "Ice-bound on Kolguev."

stellaris is to be seen. Frequently one stumbles through a growth of downy Willow (*Salix lanata*) not higher than the knee, from which, at times, a Willow Grouse rises, wild as any hawk. The flora of the tundra proper is not rich in species nor in colouring. The typical plants are:

Rubus chamœmorus.
Empetrum nigrum.
Salix lanata.
Betula nana.
Nardosmia frigida.
Sedum rhodiola.
Pedicularis hirsuta.
,, *lapponica.*
Saxifraga stellaris.
Polemonium pulchellum.

Whilst around the pools and wet spots are found:

Ranunculus pallasii.
Hippuris vulgaris.
Eriophorum angustifolium.
,, *scheuchzeri.*

Each peat hag and mound is Lichen-covered, and probably the Lichen flora is the richest of all; it is quite the distinguishing feature of the tundra.

The Gobista River, which rises at the base of Mount Siekherher in the interior and elevated part of the island, then flows west as a shallow, muddy stream, but when it reaches the tundra, or flat portion of the island, it has excavated through the soft clay and mud-beds a valley quite out of proportion to the river as it now runs. This valley is, in parts, as much as a mile and a half wide, decreasing in places to half a mile across. On either side it is bounded by bluffs, forty to ninety feet in height. At angles where the present river abuts, and erosion is in process, the mud walls are perpendicular; but as the stream has shifted its course from one side of the valley to the other, miles of bluff have been left to moulder, and these now descend with more or less abrupt slopes. The bottom-lands through which the Gobista River winds is dotted over with meres and pools of water, around which *Ranunculus pallasii* and *Hippuris vulgaris* are two of the commonest plants. It is in these localities that the wild Swan, *Cygnus bewickii*, makes its nest on a mound of moss, built up by the birds for that purpose, whilst on the drier slopes, the Little Stint, *Tringa minuta*, is found depositing its four eggs in an artless nest. On the slopes of this valley and facing south, the greatest abundance of flowering plants was met with. Many kinds that dare not face the bleak tundra with its cutting winds there nestle in warm corners or on sheltered banks. The beauty of the flowers in some of these favoured nooks is difficult to describe, without laying one's self open to the suspicion of exaggeration. Be it remembered that the traveller sees them under exceptional circumstances. For days before, he may have been sailing through fog and surrounded by ice; or he lands on some bleak and inhospitable shore, where only a few dwarfed and struggling plants are to be met with; or, driven from the monotonous tundra by sharp wind or snow-showers, he seeks shelter in the valley. Turning some corner, his eyes are greeted with a floral display, quite unexpected, and in marked contrast with the scenes lately passed through, which cannot fail to make a lasting impression. The following is a record of such a bank, noted on the spot. Here are masses of blue Gentian (*Gentiana verna*), of superb colour, with a wealth of Forget-me-nots (*Myosotis alpestris*), intermingled with *Polemonium cæruleum*. Contrasting with these lovely shades of blue are yellow twin-flowered Violets (*Viola biflora*), in dense beds, patches of Buttercups (*Ranunculus acris*), with Potentilla, Marsh-marigold, and Globe-flower (*Trollius europæus*), waving highest of all, *Silene acaulis* in clumps, with its pink mass of bloom, *Sedum rhodiola* scattered broadcast, with Alpine Milk-vetch, *Oxytropis sordida*, *Hedysarum obscurum*, Wood Geranium, Valerian, and Veronica, Willow bushes, a carpeting of grasses, and large beds of our common Lady's-mantle.

It is apparent from these observations that the flora of the western side of Kolguev is richer than that of the east coast, where the ice clings to the shore throughout the year. This is shown by a comparison of the list of plants, obtained chiefly in the valley of the Gobista, with that made by Mr. Trevor-Battye on the eastern side of the island and the elevated interior. The much earlier date on which flowers blossom on the western side is also noticeable. This difference in favour of the western side may be accounted for by the shelter afforded in its valleys, and the tempering influence of the Gulf Stream, which extends to the Sea of Barents.

Our previous knowledge of the flora of Kolguev is confined to two authorities, the first being the celebrated botanist Ruprecht, who, as already mentioned, made his visit to Kolguev in 1841. The list of flowering plants collected by him on the island is given in his work entitled *Flores Samoyedorum Cisuralensium*. The other is Mr. Trevor-Battye, who in 1894 found ninety-six flowering plants on Kolguev, and in his work[1] gives a list of twenty-one others recorded by Ruprecht, and which Mr. Trevor-Battye did not meet with himself, bringing up the total number of flowering plants then known from Kolguev to one hundred and seventeen.

The following additions made by me to the flora of the island brings the number of flowering plants and vascular cryptogams found on Kolguev to one hundred and forty-seven:—

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[1] "Ice-bound on Kolguev," pp. 396–415.

Cochlearia arctica.
Draba incana.
Alsine biflora.
Wahlenbergia affinis.
Silene acaulis.
Montia fontana.
Hedysarum obscurum.
Epilobium angustifolium.
Saxifraga decipiens.
Gentiana tenella.
Primula sibirica.
Trientalis europea.
Pinguicula alpina.
Plantago maritima.
Kœnigia islandica.
Allium sibiricum.
Juncus arcticus.
Luzula multiflora.
Carex aquatilis.
„ *dioica.*
„ *limosa.*
„ *glareosa.*
„ *salina.*
„ *vaginata.*
Eriophorum angustifolium.
„ *scheuchzeri.*
Aira cæspitosa.
Calamagrostis stricta.
Poa alpina.
Equisetum arvense.

I add a few notes on some of the plants met with.

RANUNCULUS PYGMÆUS Wahl. Common on clayey banks, and on the sides of runnels in the tundra. Fully in flower during July on the west side of the island.

RANUNCULUS ACRIS L. *f. borealis* Trautv. Very common in the Gobista valley on slopes and banks. Grows in clumps and clusters of blossom. Flowering fully in July.

RANUNCULUS PALLASII Schlecht. Abundant around the pools and meres on the tundra, likewise in similar places in the valley of the Gobista. Its long roots grow in the water, and the white flowers float on the surface. They have a delicate and pleasant scent, somewhat akin to that of an almond.

RANUNCULUS LAPPONICUS L. Rare, only observed in a few moss-clad pools on the tundra and in the valley of the Gobista.

RANUNCULUS HYPERBOREUS Roth. *f. samoyedorum* Rupr. This diminutive plant was detected by seeing its bloom, like minute yellow seeds, scattered over the wet moss of small pools on the tundra. It is a water-loving species like the preceding, and its comparatively long roots pass between the moss into the water below.

TROLLIUS EUROPÆUS L. Common in some parts of the Gobista valley, generally on banks facing south. We found it in flower during July. This plant was so abundant at one spot in the Gobista valley, some five miles from the sea, that we named it Trollius Point.

Delphinium (?). A Larkspur in bud, not in blossom, was met with in the Gobista valley. Probably *D. elatum* L., as this species was found by Mr. Trevor-Battye.

Cardamine pratensis L. Quite common, and spread over the bottom-lands of the Gobista. Lilac-coloured blossoms were met with as well as white ones, though Mr. Trevor-Battye's experience is the reverse.

Arabis alpina L. Rather uncommon. Grows on the barest banks which slope down from the tundra to the Gobista valley.

Viola biflora L. One of the most abundant flowers on the banks of the Gobista valley. Fully in flower during July, and equalling in strength and size of blossom the finest Norwegian specimens.

Viola epipsila Ledeb. Not at all uncommon on the banks of the Gobista valley. Out of hundreds of plants looked at, all had well-developed leaves, which is quite the opposite to Ruprecht's experience.

Silene acaulis L. Very common in the vicinity of the Gobista. The clumps of blossom varied from deep pink to a pure white colour.

Arenaria peploides L. Common enough on the great sand and gravel terraces which bar the estuaries of the Kriva and Gobista rivers.

Geranium sylvaticum L. Common enough in the Gobista valley, just opening into flower the middle of July.

Hedysarum obscurum L. Common in the Gobista valley, only coming into flower the middle of July.

Rubus arcticus L. This lovely flower was not uncommon in the Gobista valley, and in gullies along the coast. I did not meet with two forms as recorded by Mr. Trevor-Battye.

Rubus chamæmorus L. Perhaps the most widely distributed and abundant plant of the tundra land.

Potentilla comarum Nestl. Not at all common. Growing by the side of pools on the tundra.

Alchemilla vulgaris L. Very abundant. Just commencing to flower the middle of July.

Saxifraga cæspitosa L. Common everywhere.

Saxifraga decipiens Ehr. Uncommon. Only a few plants found which grew in clumps.

Saxifraga cernua L. Common everywhere, and of remarkably fine growth.

Saxifraga rivularis L. Common in damp spots, both on the tundra and in valleys.

Saxifraga stellaris var. *comosa* Poir. Common, especially on the tundra.

Saxifraga hirculus L. Common; when growing on dry and exposed situations of a stunted character, but in damp places attaining its normal size as we meet with it in Britain.

Saxifraga hieracifolia W. & K. A noticeable plant when seen growing on the tundra, as it is usually isolated, and attains a height of six or seven inches.

Parnassia palustris L. Common in the swamps of the Gobista valley.

Sedum rhodiola D. C. Very common, especially on the bluffs overhanging the sea.

Hippuris vulgaris L. Abundant in the pools and meres, both on the tundra and in the valleys.

Pachypleurum alpinum Ledeb. Common on the slopes of the Gobista valley.

Archangelica officinalis Hoffm. Very common by the seaside around the estuary of the Gobista.

Erigeron uniflorus L. Common.

Gnaphalium supinum L. Common; not in flower up to the middle of July.

Matricaria inodora var. *phæocephala* Rupr. Very common along the west coast; in some sheltered spots it grew abundantly, with blossoms the size of a penny-piece.

Saussurea alpina D. C. Common; but not fully in flower by the middle of July.

Vaccinium uliginosum var. *microphyllum* Lange. Common on the peaty lands of the tundra.

Vaccinium vitis-idæa L. var. *pumilum* Horn. Common on the peaty lands of the tundra.

Arctostaphylos alpina Spreng. Common; flowering in July.

Pyrola minor Sw. Not common; but found flowering in some of the side ravines of the Gobista valley, and more abundantly in a ravine five miles to the northward.

Gentiana verna L. One of the most lovely plants we met with, growing in beds on the slopes of the Gobista valley. The masses of deep blue blossom were very striking.

Gentiana tenella Fries. This small Gentian was found in only one locality, a ravine some five miles north of our camp.

Armeria vulgaris var. *arctica* Cham. Extremely abundant on the weather-beaten summits of the sea-bluffs.

Primula stricta Horn. Common on the slopes leading down from the tundra in ravines, and likewise in the valleys.

Primula sibirica L. var. *finmarkica* Jacq. We first met with this beautiful Primrose on the banks of the Gobista, some five miles from the sea. It was in full flower during July. We came across a bed of this plant near the mouth of the Kriva, not less than a quarter of an acre in extent, and a mass of bloom.

Trientalis europea L. Only met with in one locality, a ravine five miles north of our camp.

Pinguicula alpina L. This plant, with its delicate waxen flower, was found growing in some abundance on bogs and damp places in the Gobista valley, some five miles inland.

Castillejia septentrionalis L. Growing as a plant six to ten inches high, on the banks of the Gobista river.

Myosotis alpestris Schmidt. Very common in the valley of the Gobista. We did not meet with *M. arvensis*, nor with *Eritrichium villosum*, which are common plants on the eastern side of the island (*vide* Trevor-Battye).

Adoxa moschatellina L. Only found in one locality, some four miles south of our Gobista camp.

Bartsia alpina L. Common on the slopes of the Gobista valley, but not fully in flower by the middle of July.

Plantago maritima L. With *Sedum rhodiola*, the commonest plant, along the wind-swept heights of the shore-bluffs, on the west side of the island.

Allium sibiricum L. Very common; on sandy banks near the mouth of the Gobista, on slopes farther inland, and near the mouth of the Kriva River.

Kœnigia islandica L. Not uncommon in damp spots on the tundra and the lowlands of the valley, where it was discovered by the Rev. H. H. Slater.

The following list includes all flowering plants and vascular cryptogams found by Dr. Ruprecht, Mr. Trevor-Battye, and myself on Kolguev:—

Ranunculus acris L. *f. borealis* Trautv.
  „ lapponicus L.
  „ hyperboreus Roth. *f. samojedorum* Rupr.
  „ pygmæus L.
  „ pallasii Schlecht.
Caltha palustris L.
Trollius europæus L.
Delphinium elatum L.
Aconitum septentrionale Willd.
Arabis alpina L.
Cardamine pratensis L.
Cochlearia arctica D. C.
  „ danica L.
Draba alpina L.
  „ hirta L.
  „ rupestris R. Br.

Draba muricella Wahl.
„ incana L.
Eutrema edwardsii R. Br.
Viola biflora L.
„ epipsila Led.
Dianthus superbus L.
Alsine biflora L.
Cerastium arvense L. var. *incanum.*
„ alpinum L.
Arenaria peploides L.
Wahlenbergia affinis Vahl.
„ angustiflora Rupr.
Sagina intermedia Rupr.
Silene acaulis L.
Stellaria longipes Goldie, *f. edwardsii* R. Br.
„ humifusa Rottb.
Montia fontana L. (1 spec. only.)
Geranium sylvaticum L.
Oxytropis sordida Willd.
Astragalus alpinus L.
Hedysarum obscurum L.
Dryas octopetala L.
Geum rivale L.
Potentilla salisburgensis Haencke.
„ comarum Nestl.
Sibbaldia procumbens L.
Alchemilla vulgaris L.
Rubus chamæmorus L.
„ arcticus L.
Epilobium angustifolium (*sine fl.*).
„ lineare L.
Saxifraga cernua L.
„ cæspitosa L.
„ decipiens Ehr.
„ hieracifolia W. & K.
„ hirculus L.
„ nivalis L.
Saxifraga rivularis L.
„ stellaris var. *comosa* Poir.
Chrysosplenium alternifolium L.
Parnassia palustris L.
„ obtusiflora Rupr.
Sedum rhodiola D. C.
Hippuris vulgaris L.
Adoxa moschatellina L.
Pachypleurum alpinum Led.
Archangelica officinalis Hoffm.
Valeriana capitata Willd.
Artemisia vulgaris, *f. tilesii* Ledeb.
Antennaria carpathica R. Br.
„ alpina R. Br.
Gnaphalium supinum L.
Erigeron uniflorus L.
Matricaria inodora L. var. *phæocephala* Rupr.
Pyrethrum bipinnatum Willd.
Achillea millefolium L.
Saussurea alpina D. C.
Nardosmia frigida Hook.
Senecio campestris D. C.
„ palustris L.
Taraxacum officinale Schrank, var. *alpinum.*
Hieracium alpinum L.
Campanula rotundifolia L.
Vaccinium uliginosum var. *microphyllum* Lange.
„ vitis-idæa L. var. *pumilum* Horn.
„ myrtillus L.
Arctostaphylos alpina Spr.
Pyrola minor Sw.
„ uniflora L.
Gentiana verna L.
„ tenella Fries.

Armeria maritima Willd.
Primula stricta Horn.
„ sibirica var. *finmarckica* Jacq.
Androsace septentrionalis L. *f. ciliata* Traut.
Trientalis europæa L.
Pinguicula alpina L.
Polemonium humile Willd. var. *pulchellum* Bunge
„ cæruleum *f. acutifolium* Willd.
Myosotis alpestris Schmidt.
„ arvensis Hoff.
Eritrichium villosum Bunge.
Veronica alpina L.
„ longifolia L.
Bartsia alpina L.
Castillejia septentrionalis L.
Pedicularis lapponica L.
„ hirsuta L.
Plantago maritima L.
Kœnigia islandica L.
Oxyria reniformis Hook.
Polygonum viviparum L.
Rumex acetosa L.
„ domesticus *f. nanus.*
Betula nana L.
Salix herbacea L.
„ myrsinites L.
„ reticulata L.
„ lanata L.
Salix lapponum L.
„ polaris Wahlbg.
Empetrum nigrum L.
Juniperus communis L. (or *nanus*).
Allium sibiricum L.
Juncus arcticus Willd.
Luzula hyperborea R. Br.
„ wahlenbergii Rupr.
„ multiflora Lej.
Carex aquatilis Wahlb.
„ dioica L.
„ limosa L.
„ glareosa Wg.
„ rigida Good.
„ stricta Good.
„ salina Wg.
„ vaginata Tausch.
Eriophorum angustifolium Roth.
„ vaginatum L.
„ scheuchzeri Hoppe.
Aira flexuosa L.
„ cæspitosa var.
Calamagrostis stricta R. Br.
Alopecurus alpinus Sm.
Festuca ovina L. et vars.
Poa alpina L.
„ flexuosa Wahl.
„ arctica R. Br.
Trisetum subspicatum P. de B.
Lycopodium selago L.
Equisetum arvense var. *arcticum*, Led.
„ palustre L.

APPENDIX C

THE FLOWERING PLANTS OF NOVAYA ZEMLYA, ETC.

BY COLONEL H. W. FEILDEN.[1]

THIS paper gives the botanical results of two visits to Novaya Zemlya and adjacent regions during the summers of 1895 and 1897. During the summer of 1895 I passed ten days on Novaya Zemlya; my investigations that season were confined to the shores and islands of Kostin Shar, and on the mainland around Rogatchiva Bay, Neckwatowa, and South Goose Land. The excursion of 1897 was on a more extended scale. Dolgoi Island, a very inaccessible spot, and as far as I know, not hitherto botanised over, was visited. More than a fortnight was passed on the island of Waigats; its northern, southern, and eastern areas were examined. The neighbourhood of Habarova, on the Russian mainland of the Yugor Straits, received some attention. In Novaya Zemlya proper, South Goose Land was revisited; Besemannya or Nameless Bay on its western coast was examined; the Matyushin Shar, separating Novaya Zemlya from the North Island, or Lütke Land, was traversed; considerable botanical collections were made from various stations on both sides of that strait, and finally, favoured by an exceptional open ice-season, the Kara Sea was entered, and the eastern shores of Lütke Land examined as far north as the Pachtussow Islands.

To save repetition of latitudes in the notes that accompany this paper, I give the parallels of the different stations where botanical collections were made. It may be borne in mind that several days were passed at many of these stations, and the surrounding country botanised over: so that the latitudes given are not absolutely correct, but are intended to convey only an approximation of the localities from whence collections were derived:

Dolgoi Island	N. lat.	69° 15′
Habarova	„	69° 40′
South shores of Waigats [Waïgatch]	„	66° 40′
Cape Greben „	„	69° 41′
Cape Matiusela „	„	70° 7′

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[1] Reprinted from the *Journal of Botany*, Oct.-Dec. 1898.

Dolga Bay, Waigats [Dolgaja Bay, Waïgatch]	N. lat.	70° 15
Cape Voronoff „	„	70° 20′
Islands in Kostin Shar	„	71° 15′
Neckwatowa	„	71° 15′
Rogatchiva Bay	„	71° 24′
Beluga Bay, South Goose Land [Belootchia Bay]	„	71° 30′
South Goose Land	„	71° 30′
Besemannya Bay (Nameless Bay)	„	72° 55′
Cairn Harbour (Pomorsky Bay)	„	73° 15′
Farassowa Valley, Matyushin Shar	„	73° 11′
Gubina Bay, „	„	73° 12′
Beluga Bay, Lütke Land [Belushja Bay]	„	73° 15′
Silver Bay, „	„	73° 25′
Patchtussow Islands	„	74° 24′
Ziwolka Fiord	„	74° 25′

The botanical literature relating to Novaya Zemlya, Waigats, and the shores of Yugor Straits is extensive. It commences with the researches of the celebrated Von Baer in 1837, and has been continued by many eminent botanists to the present time. Few Arctic lands have received greater attention from distinguished botanists than Novaya Zemlya. We may, I think, conclude that our knowledge of the species that compose its phanerogamic vegetation is practically complete. Further investigations may add a few species to the list, and will of course increase our acquaintance with the geographical range of species in the North Island.

It is, however, tolerably well accepted that the Arctic flora is divided into three groups—Asiatic, European, and American—that differ slightly from one another, and the limits of these groups are well known. There is, however, a point in connection with the dispersal and spread of these groups over the polar area deserving of consideration, and one which I shall refer to subsequently in greater detail. Is the generally accepted assumption correct that during the so-called glacial epoch an ice-cap over the polar area obliterated phanerogamic and all other vegetation, and that the entire present polar flora is due to subsequent immigration from the south? It appears to me that there is evidence at our command which may induce us to pause before accepting this theory as an unquestionable fact, and there certainly are peculiarities in the distribution of the existing polar flora that point to the survival and subsequent extension of what may be called a palæarctic flora. The already recorded species of phanerogamic plants and vascular cryptogams from Novaya Zemlya and Waigats amount to about 200; my collections of 1895 and 1897 embrace about five-sixths of that flora. Of these, only eight are additions; they are:—

Ranunculus auricomus L.
Alsine imbricata C. A. M.
Potentilla nivea L.
Gentiana tenella Fr.
Empetrum nigrum L.
Veratrum album L.
Poa abbreviata R. Br.
Koeleria cristata Gaud.

I have included in this paper a series of field notes, giving some information in regard to distribution, relative abundance, and other particulars about the various plants met with, and also a brief sketch of the topographical features of the different islands and places visited.

It is my pleasant duty to render sincere thanks to several distinguished botanists for the assistance given me in identifying my Arctic collections of 1895 and 1897, which amounted to several thousand specimens. Especially to Professor Eugene Warming and Mr. O. Gelert, of the Royal Botanical Museum, Copenhagen; to Mr. Theodor Holm, the botanist to the Danish "Dijmphna" Expedition; to Mr. Arthur Bennett, Mr. H. D. Geldart, and to Mr. H. Chichester Hart, my colleague in the British Polar Expedition of 1875–76; to the members of the staff of the Department of Botany, British Museum, and of the Kew Herbarium, more particularly to Mr. I. H. Burkill, who examined the whole of my plants.

DOLGOI ISLAND

Lies between 69° 4′ and 69° 20′ N. lat.; it is about seventeen miles in length from north to south, and in width from a mile and a half to two miles. It is five miles due north from Cape Medinsky Zavarot, of the mainland of Russia. The island is flat, the greatest elevation not rising more than fifty feet above the sea. The rock exposures, which are visible all round the shores of the island, consist of finely crystalline, hard unfossiliferous dolomitic limestones, probably of palæozoic age. The surface is covered with marine boreal deposits; in many parts these are overlain by modern peat deposits, and a network of shallow lakes and meres occupies at least one-half of the island, which, viewed from the sea, looks like a piece of the adjoining mainland tundra surrounded by the ocean.

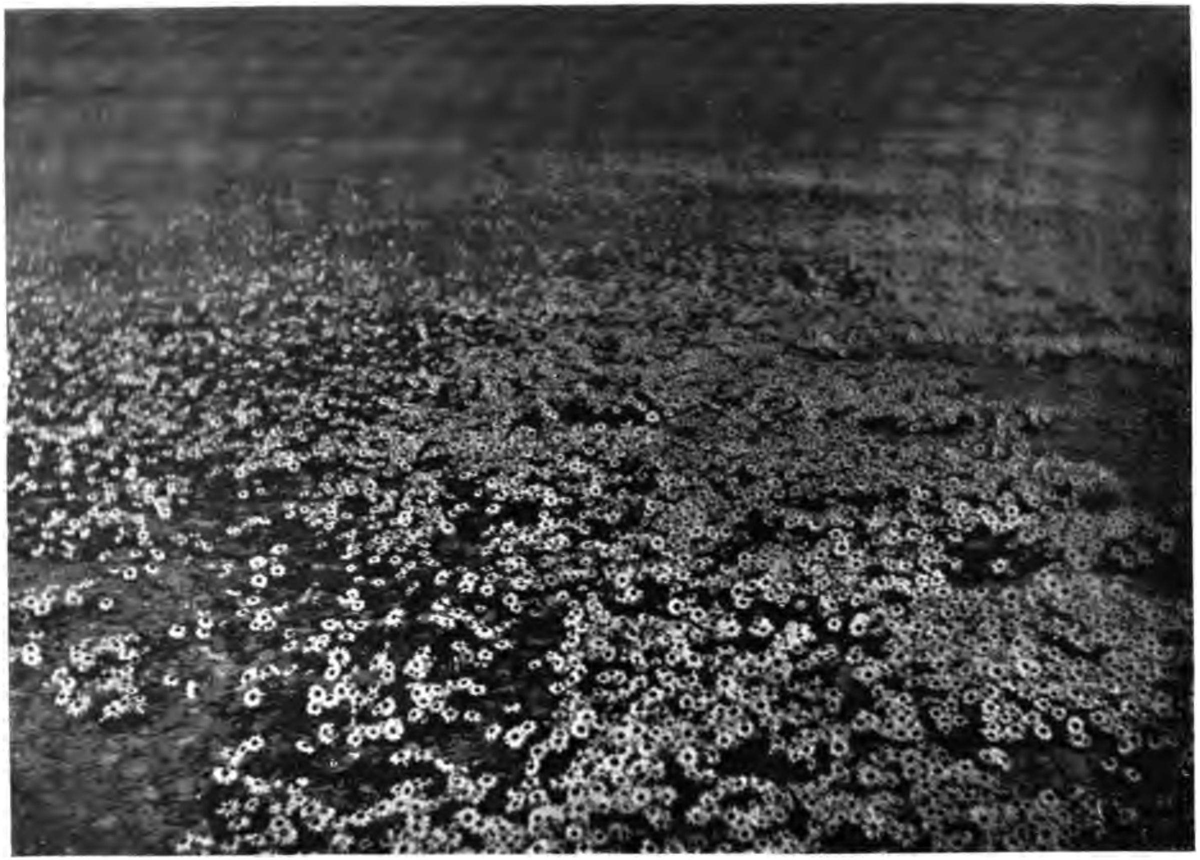
The proofs of recent emergence are strikingly apparent, and the natural surmise is that we should find the flora of the island simply an extension of that of the neighbouring mainland. An examination of its flora shows this to be the case, for, out of seventy-three phanerogams and two vascular cryptogams found on the island, all but one, *Tofieldia palustris*, are recorded from the shores of Yugor Straits, or the great tundra of the Samoyeds, in Eastern Europe. The most striking characteristic of the flora of Dolgoi Island is the abundance of two species of *Ericaceæ*, namely, *Cassiopeia tetragona* and *Andromeda Polifolia*, and likewise of *Empetrum nigrum*.

In a hasty examination, extending over a few hours, of an island as large as Dolgoi, the list of its plants cannot have been exhausted; but there is no reason to suppose that future investigation will alter the conclusion here arrived at, that the flora of Dolgoi Island is a reduced representation of that of the adjacent mainland.

The following is a list of the plants obtained on Dolgoi Island, 20th July 1897:—

Ranunculus Pallasii Schl.
R. sulphureus Sol.
R. hyperboreus Roth. f. *Samoyedorum* Rupr.
Caltha palustris L.
Papaver nudicaule L.
Cardamine pratensis L.
Eutrema Edwardsii R. Br.
Cochlearia fenestrata R. Br.
Draba alpina L.
D. Fladnizensis Wulf.
D. repens Bieb.
Silene acaulis L.
Stellaria humifusa Rottb.
S. longipes Goldie.
Cerastium alpinum L. f. *hirsutum* Koch.
Arenaria ciliata L.
Hedysarum obscurum L.
Rubus Chamæmorus L.
Comarum palustre L.
Dryus octopetala L.
Hippuris vulgaris L.
Saxifraga oppositifolia L.
S. Hirculus L.
S. aizoides L.
S. comosa Poir.
S. cæspitosa L. f. *decipiens* Ehrh.
S. cernua L.
S. hieracifolia Wald. & Kt.
Chrysosplenium alternifolium L.
Parnassia palustris L. f. *alpina* Drude.
Sedum Rhodiola D. C.
Epilobium palustre L.
Valeriana capitata Pall.
Senecio campestris D. C. var. *integrifolia* Hook.
Petasites frigida Fries.
Cassiopeia tetragona L.
Andromeda Polifolia L.
Vaccinium Vitis-idæa L. f. *pumila* Horn.
Primula stricta Horn.
Armeria sibirica Turcz.
Polemonium cæruleum L. f. *acutifolia* Willd.
Myosotis alpestris Koch.

PLATE 77.



F. 11. 1/5 *S*. 1.15 *p.m.* 8-7-97.

MATRICARIA INODORA.

DOLGAJA BAY, WAÏGATCH.

Gentiana tenella Fr.
Pedicularis sudetica Willd.
P. lapponica L.
Plantago maritima L. f. *pumila* Kjllm.
Polygonum Bistorta L.
P. viviparum L.
Empetrum nigrum L.
Betula nana L.
Salix Myrsinites L.
S. arctica Pall.
S. rotundifolia Trautv.
S. reticulata L.
Tofieldia palustris Huds.
Allium sibiricum L.
Juncus biglumis L.
Luzula Wahlenbergii Rupr.
L. arctica Blytt.
Eriophorum Scheuchzeri Hoppe.
E. callithrix Cham.
E. russeolum Fr.
E. angustifolium Roth.
Carex rariflora Sm.
C. rigida, Good.
C. fuliginosa Schk.
C. glareosa Wahlenb.
C. rotundata Wahlenb.
Dupontia Fischeri R. Br.
Arctophila fulva Nym.
Poa alpina L.
P. cenisia All.
Deschampsia cæspitosa Beauv. f. *brevifolia* Trautv.
Equisetum arvense L.
Lycopodium Selago L.

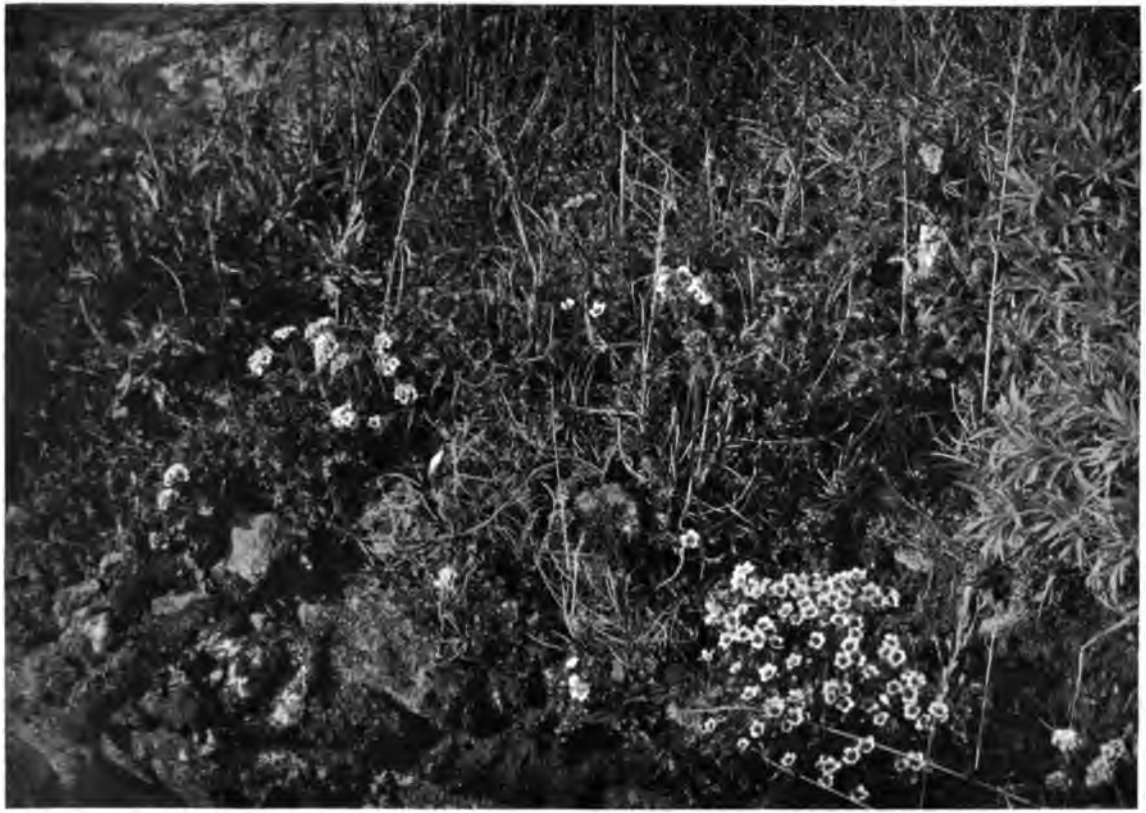
WAIGATS [Waïgatch].

This island, which is separated by the narrow Straits of Yugor from the mainland of Arctic Russia, lies between the parallels of 69° 40′ and 70° 25′ N. lat. It is about sixty miles in length and about twenty in width. The southern end of the island is generally low and swampy, the knolls and eminences rising not more than fifty feet above the level of the sea. Looking at it from the Yugor Straits, it appears as a reflection of the opposite mainland. A few miles inland from its southern end the country becomes hilly, and when we examine its topographical features with more care, we find that these hills associate themselves into series of ridges, with a general trend from north-west to south-east, and running parallel to one another. These ridges do not anywhere exceed a height of 300 feet, as a rule they are considerably lower, and, roughly speaking, average from 70 to 100 feet.

The rock formations of Waigats consist chiefly of slates, shales, limestones, and dolomitic limestones; all have undergone great upheaval and subsequent denudation. They are nearly vertical, and their strike is from north-west to south-east. Consequently the ridges are formed by the lines of strike, and run in the same direction. The troughs or valleys between the ridges, and all the level or tundra land, are covered with a thick layer of marine boreal clay containing the shells of mollusca now occurring abundantly in the surrounding sea. Everywhere around we can trace the proofs of recent emergence from the ocean. The present island of Waigats is, geographically, an upheaval of yesterday. The clay deposit in the valleys and troughs is dotted over with meres and lakes. Many of these are surrounded with peaty growths. Waigats has no glaciers, and no attempt indeed at any permanent snow deposit. In June and July, as I saw it, the snow had generally disappeared, and only remained in scattered patches on northern slopes or in hollows; it was then difficult to realise what severe winter conditions obtain there. Thus we have in Waigats three distinct areas for the growth of plants—the disintegrated rock ridges, the predominant marine boreal clay, and the more local peat formations resting on the clay. To each of these areas certain plants appear to be restricted, whilst others are spread broadcast. Later on, under the heading of the various species obtained, are remarks as to the localities they chiefly affect. There are no trees, in the ordinary acceptance of the word, growing on Waigats, but several species of *Salix* are abundant; they are, however, only stunted bushes, not growing higher than a foot to a foot and a half. *Betula nana* appears as a procumbent plant. Viewed in summer, the surface of Waigats does not present an extreme boreal aspect. There is a good carpeting over the valleys and flats of *Gramineæ*, *Juncaceæ*, Carices, and Mosses, which gives a verdant colouring to the landscape. In some spots bright flowering plants are met with in great profusion, so that Waigats does not by any means give the impression of a bleak, sterile, Arctic land, but rather of one where domesticated reindeer might thrive and multiply.

NOVAYA ZEMLYA AND LÜTKE LAND.

Viewed from seaward, the southern and south-western portions of Novaya Zemlya, though rising in parts to a considerably greater altitude than Waigats, present a gloomy and uninteresting appearance. In summer the snow is removed from the mountains, only remaining in patches, and there are no glaciers or mer-de-glace. The flat island of Meshdusharsky and low-lying Goose Land extend as wide breadths of tundra between the inland ranges and the sea, so that the mountains of the interior, probably some 2000 feet high in that latitude, are dwarfed by distance. The flora of Goose Land has the same general character as that of Waigats, but one speedily realises that it is far poorer. We notice a great falling off in the number of *Compositæ;* especially *Senecio campestris* and *S. frigidus*, which brighten the peaty land of Waigats; *Rubus*



F.64. 12 S. 5.0 *p.m.* 6-7-97.

ANDROSACE CHAMÆJASME. SAXIFRAGA CÆSPITOSA.

DOLGAJA BAY, WAÏGATCH.

Chamæmorus, which in Waigats covers acres with large white blossoms, is there dwarfed and stunted; *Androsace Chamæjasme*, which speckles leagues of Waigats with its small flowers, is absent; and *Primula farinosa*, so abundant in that island, is hardly met with in Goose Land; whilst *Lloydia serotina* and *Allium sibiricum*, conspicuous plants of Waigats, seem altogether absent from Novaya Zemlya. As we proceed northward the mountains increase in height, until in the neighbourhood of the Matyushin Shar the ranges of Novaya Zemlya rise in series of bold and lofty peaks, snow-clad, and entwined by glaciers. Phanerogamic vegetation in that alpine region is consequently restricted to the shoreline, the valleys, and the uncovered slopes; I cannot say with absolute exactness at what altitude phanerogamic vegetation ceases, but at 1000 feet it is there very scarce. The same majestic scenery appears in Lütke Land, the interior mountains rising from seas of ice, with glaciers descending to the ocean, but there is very little difference between the floras on the north and south shores of the Matyushin Shar. Farther north, on the Pachtussow Islands and the mainland in the zone of 74°–75°, I gathered some fifty phanerogamic plants, a serious falling off from the number recorded from the shores of the Matyushin Shar in the zone of 73°–74°. There now remains for the botanical explorer the examination of the shores of Barents Land, in the zone of 75°–77°, which, so far, has only been credited with some sixteen species.

I will now give a few details in regard to the flora.

1. Ranunculus Pallasii Schl. Rare on Dolgoi Island; found in one lake only. Common in lakes around Habarova. Abundant in lakes and meres all over Waigats, perfuming the air in their vicinity with its delicious scent. Not met with by me in Novaya Zemlya proper, but abundant near the Notschujew River, Lütke Land, north side of the Matyushin Shar, near entrance to the Kara Sea.

2. R. lapponicus L. Only met with by me at Cape Matiusela, island of Waigats, where it grew in abundance on sphagnum-covered swamps.

3. R. hyperboreus Roth. A very common plant growing in swamps. Found on Dolgoi Island, in the neighbourhood of Habarova, all over Waigats, in Novaya Zemlya, and Lütke Land; specimens from Beluga Bay, 73° 20′ N., being of the same character as the plant in North Russia. After an examination of scores of specimens, I cannot separate *R. Samojedorum* Rupr. from this species. Plants agreeing in every respect with Ruprecht's description of *R. Samojedorum*[1] were brought from Dolgoi Island, and Cape Greben, Waigats.

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[1] Symb. Hist. Plant. Ross., F. J. Ruprecht, St. Petersburg, 1846, p. 18.

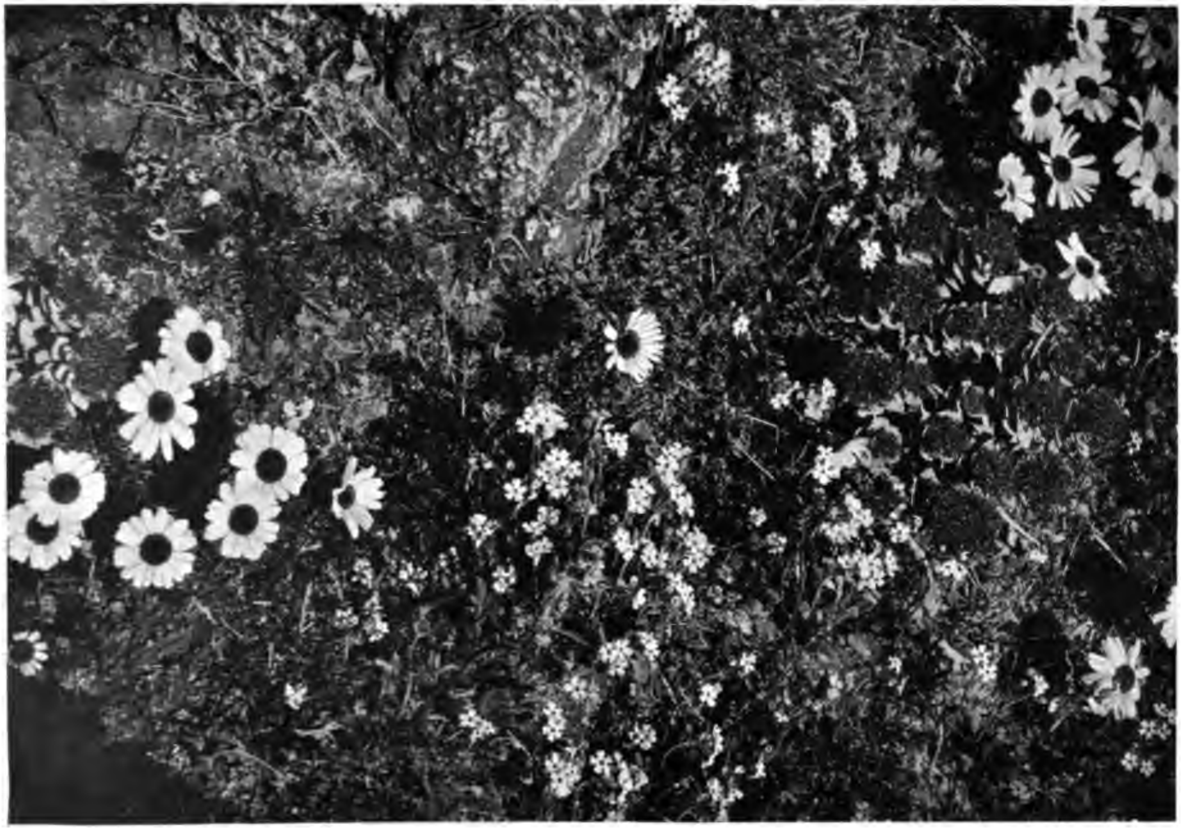
4. R. PYGMÆUS Wahlenb. A very generally dispersed plant, and variable in growth; on bleak and exposed situations the blossoms are minute and resting on the ground; in sheltered and moist spots this plant attains a height of four inches. Cape Greben; south shores of Waigats; Cape Matiusela; Dolga Bay, 150 feet; Neckwatowa; Islands Kostin Shar; Nameless Bay; Beluga Bay, Lütke Land; Ziwolka Fjord, 74° 25′.

5. R. NIVALIS L. A common species, extending from the shores of the Russian mainland to the extreme point visited in Lütke Land. Still, out of more than a hundred examples of this and the following plant gathered at many stations, *R. sulphureus* appears in the collection in the proportion of five to one. Habarova; south shores of Waigats; Dolga Bay; Neckwatowa; Islands Kostin Shar; Gubina Bay; Beluga Bay, Lütke Land; Ziwolka Fjord; Pachtussow Islands.

6. R. SULPHUREUS Sol. As a rule, this is a finer and more showy plant than *R. nivalis*. There are specimens from Cape Matiusela seven inches in height, with blossoms over an inch in diameter. The range and distribution of this species coincides with that of *R. nivalis*. Dolgoi Island; south shores of Waigats; Cape Matiusela; Dolga Bay; Neckwatowa; Nameless Bay; Gubina Bay; Goose Land; Beluga Bay, Lütke Land; Pachtussow Islands; Ziwolka Fjord.

7. R. ACRIS L. f. *borealis* Trautv. The commonest buttercup throughout the regions visited. Extending from the sea-shore to altitudes of two hundred feet and more. This is a most variable plant, and without the connecting links it would puzzle the ordinary observer to decide that the extremes belong to the same species. There are in the collection specimens from Waigats, and Lütke Land as well, with stalks over eight inches in length, and blossoms an inch and a quarter in diameter; and from the same localities specimens with stalks of not more than half an inch, and blossoms three-quarters of an inch in diameter. Habarova; south shores of Waigats; Cape Matiusela; Dolga Bay; Islands Kostin Shar; Neckwatowa; Goose Land; Nameless Bay; Gubina Bay; Silver Bay; Beluga Bay, Lütke Land.

8. R. AURICOMUS L. Found at Cape Voronoff, 2nd of July 1897, where it grew in beds on sandy hillocks close to the seashore. It was not uncommon around Beluga Bay, Lütke Land, reaching an altitude of one hundred feet. It does not appear in the collections from any of the other stations. It is just possible that this may be the *R. affinis* recorded by other botanists from Novaya Zemlya, but after a careful comparison with specimens of *R. affinis* from many quarters, including Robert Brown's type in the herbarium of the British Museum



F. 64. 10 S. 3.45 p-m. *11-7-97.*

MATRICARIA INODORA. PRIMULA FARINOSA. PACHYPLEURUM ALPINUM.

CAPE GREBEN, WAÏGATCH.

(Natural History), I cannot assign these plants to anything but true *R. auricomus* L. Mr. Burkill attached the following note to the specimens of this plant submitted to him:—"*R. affinis* R. Br., a North American plant—perhaps a confusion of two or three forms specifically distinct—is in its Arctic type difficult to distinguish from *R. auricomus* L. Types of the original plant so named by Robert Brown exist at Kew and at the British Museum, and may be, as Lange points out, distinguished from *R. auricomus* by the longer head of fruit. To *R. auricomus* I refer the plant from Waigats collected on the Nordenskiold Expedition, and named *R. affinis*, a specimen of which exists at Kew. Fellmann (*Plantæ Arcticæ*, No. 5) has distributed a very similar plant from Eastern Lapland. You were fortunate or careful enough to collect the round head of fruits, which is that of *R. auricomus*, and not of *R. affinis*. The latter, therefore, is apparently to be removed from the Novaya Zemlya list (Waigats zone), and to be replaced by *R. auricomus*."

9. CALTHA PALUSTRIS L. An extremely common plant throughout the regions visited, growing round lakes and meres, in bogs, and by the banks of rivulets. It shows great variations according to locality. In favoured spots the plants are as large, and with as fine blossoms, as typical specimens from an English meadow, whilst at high altitudes, for instance at three hundred feet in Lütke Land, we find the plant degenerated to an almost leafless stem, showing only a small blossom of a quarter of an inch diameter just protruding above the damp moss in which the stalk lies hidden. There are specimens in the collection from Waigats with flowers two inches in diameter. Dolgoi Island; Habarova; Cape Greben; south shores of Waigats; Cape Matiusela; Dolga Bay; Neckwatowa; Kostin Shar; Goose Land; Gubina Bay; Beluga Bay, Lütke Land; Pachtussow Islands; Ziwolka Fjord.

10. THALICTRUM ALPINUM L. Is not uncommon from the shores of the mainland of Russia to Lütke Land. It affects protected spots, growing under the sides of runnels, on sheltered banks, or in the clefts of rock exposures. Habarova; south shores of Waigats; Dolga Bay; Neckwatowa; Islands Kostin Shar; Gubina Bay; Beluga Bay, Lütke Land; and many other localities.

11. PAPAVER NUDICAULE L. Of the entire flora in the Polar and Arctic regions no flower is dearer to the explorer than the Arctic poppy. Its beauty, its delightful shades of colour, from white to bright yellow and delicate pink, charm the eye. Its abundance and vitality under apparently the most adverse circumstances make a deep impression. On the bleakest and most exposed surfaces, as far north as the explorer has reached on land, this remarkable flower has been met with. Cold, snow, and tempest seem to make no impres-

sion on it. Habarova; Dolgoi Island; Waigats; Novaya Zemlya generally; Lütke Land generally; Pachtussow Islands; Ziwolka Fjord. Seeds of this plant gathered in Novaya Zemlya, sown in the end of May 1898, came up strongly in fourteen days, and one blossomed (white) first week of July.

12. **Mathiola nudicaulis** Trautv. Is extremely abundant over Waigats and Novaya Zemlya, decreasing, however, as we cross Matyushin Shar and enter Lütke Land. Its beautiful pink blossoms (sometimes pure white) are a distinct feature in the floral display. This plant especially affects areas covered by marine boreal clay, its strong roots penetrating several inches into the ground. Habarova; Waigats generally; Novaya Zemlya generally; Beluga Bay, Lütke Land; Pachtussow Islands; Ziwolka Fjord.

13. **Cardamine pratensis** L. Generally distributed in suitable places from the shores of the Russian mainland to Lütke Land, where it was found in flower on the Pachtussow Islands, 74° 24′ N. Dolgoi Island; Habarova; Waigats; Novaya Zemlya; Beluga Bay, Lütke Land; and Ziwolka Fjord. The depth of the tubular part of the flower, *i.e.* length of claw of petal, may be worth mention, for it is found to be a very variable feature, longer in some localities than in others, but probably having a definite relation to the tongues of the insects which fertilise the flower.

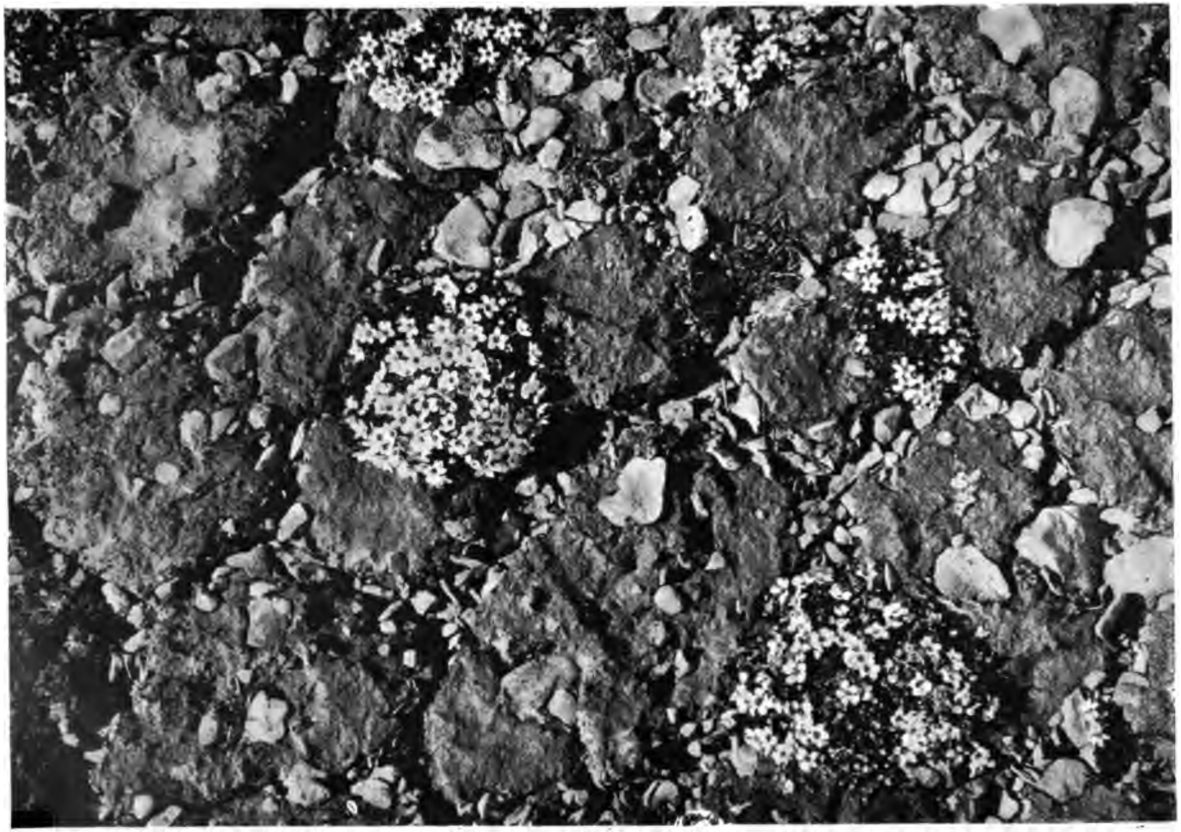
14. **C. bellidifolia** L. Not met with by me on Dolgoi Island, but extremely common all over Waigats, the same in Novaya Zemlya, and was found in flower at an altitude of 1000 feet in the neighbourhood of Ziwolka Fjord, Lütke Land, 74° 25′ N. It attains the highest altitude of any plant I have observed in Novaya Zemlya.

15. **Arabis alpina** L. Found in the neighbourhood of Habarova; on Waigats, but not common; at Neckwatowa, Novaya Zemlya; rare. Not found or overlooked in Lütke Land.

16. **A. petræa** Lam. Found in considerable quantity growing in clefts of a cliff at the head of Dolga Bay, Waigats; at Neckwatowa, at Nameless Bay, and Gubina Bay, where it grew in clumps on the gravel terraces a few feet above tide-level. Not found or overlooked by me in Lütke Land. This plant has in some instances a delicate perfume.

17. **Eutrema Edwardsii** R. Br. A very common and generally distributed plant over the tundra land of Waigats; common on Dolgoi Island; abundant on Novaya Zemlya; common around Beluga Bay, Lütke Land, but not observed by me farther north than 73° 25′.

18. **Braya alpina** Koch. A very common and very pretty plant, growing all over the island of Waigats, especially affecting areas covered by marine boreal



F. 64. 10 *S.* 3 *p.m.*

11-7-97.

SILENE ACAULIS (WHITE).

CAPE GREBEN, WAÏGATCH.

clay; into this its strong roots descend perpendicularly to as much as seven or eight inches. It is common around Habarova, but not met with or overlooked by me on Dolgoi Island. Common over Novaya Zemlya, and met with in flower at Beluga Bay and Silver Bay of Lütke Land.

19. **CHEIRANTHUS PYGMÆUS** Adams. Only met with 31st July at one station, Beluga Bay, Lütke Land, where a small number of plants were growing together at an altitude of 100 feet. The largest plant stood some seven inches above the ground; its seed-pods, some three inches in length, were so ripe that on gathering the plant they opened and the mature seed fell out. The impression given me was that the smaller plants surrounding it were seedlings of a prior season.

20. **COCHLEARIA FENESTRATA** R. Br. Many specimens of scurvy-grass were brought back from various localities, but all have been pronounced by competent authorities *C. fenestrata.* On Dolgoi Island; around Habarova, all over Waigats; Novaya Zemlya, and in Lütke Land it is a common plant. It is noticeable that when growing close to the shore it is generally a close-leaved procumbent herb, becoming more luxuriant at higher altitudes. On Waigats, at an elevation of 250 feet, it grew as a straggling plant with stalks seven to eight inches high. It was growing abundantly from shore-line to summits of the Pachtussow Islands; likewise in Ziwolka Fjord.

21. **SCHIVERECKIA PODOLICA** Andrz. Only met with by me at Neckwatowa, Novaya Zemlya, in July 1895.

22. **DRABA ALPINA** L. Is the commonest and most widely distributed of the *Drabæ* over Dolgoi Island, Waigats, Novaya Zemlya, and Lütke Land. It extends from the sea-shore to elevations of 400 feet. As a rule the blossom is of a bright yellow.

23. D. **REPENS** Bieb. Is common around Habarova, on Dolgoi Island, and widely dispersed over Waigats; not observed by me on Novaya Zemlya, though found on the south end of that island by Mr. Theodor Holm. Apparently it does not extend beyond 71°. Its manner of growth is singular—always in moss; the flower and leaves appear through the moss, but the plant stems ramify horizontally as runners for a great length.

24. D. **HIRTA** L., type, and its var. *rupestris* Hart. Around Habarova, abundant over Waigats, common on Novaya Zemlya, but not included in my collections from Lütke Land.

25. D. **FLADNIZENSIS** Wulf. A widely spread species from the mainland of Arctic Russia to 74° 25′ N. Dolgoi Island; Habarova; Dolga Bay; north end of Waigats; Kostin Shar; South Goose Land; Beluga Bay, Lütke Land; and Ziwolka Fjord.

26. D. **MURICELLA** Wahlenb. Apparently a scarce plant, for it is not easy to confound this with any other species of *Draba*. Only found by me on the north end of Waigats at an elevation of 200 feet, where it was growing abundantly on the summit of a range of hills. In Novaya Zemlya, at Neckwatowa. Not found or overlooked by me in Lütke Land.

27. **VIOLA BIFLORA** L. Only met with in one locality—the east side of Dolga Bay, island of Waigats, on the 8th July 1897. It was growing in peaty soil in great abundance and in full flower.

28. **SILENE ACAULIS** L. Universally distributed, from the mainland of Arctic Russia to Lütke Land, as far as explored by me in lat. 74° 25′ N.; Habarova; Dolgoi Island; Waigats; Novaya Zemlya; Beluga Bay, Lütke Land; Pachtussow Islands.

29. **WAHLENBERGIA APETALA** Fries. Scores of specimens of this plant were gathered from various localities, with the object of elucidating the intergrading of this species with the next. The conclusion I arrived at is that *W. apetala* is distinctly a plant of the damp tundra-ground, affecting wet peaty ridges and bogs, *W. affinis* the plant of the dry or rocky ground *W. apetala* is an abundant species around Habarova, on Dolgoi Island, all over Waigats and Novaya Zemlya in suitable localities, growing freely in Lütke Land; at Beluga Bay specimens were gathered in flower ten inches in height. It was common on the Pachtussow Islands and in Ziwolka Fjord.

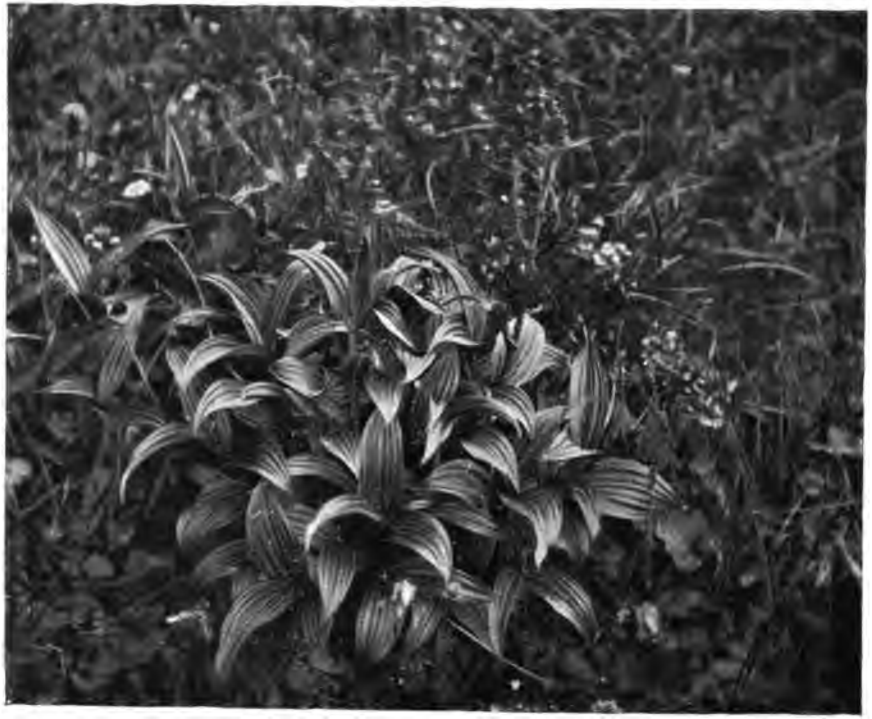
30. W. **AFFINIS** Vahl. As already mentioned, this plant, as far as my observation goes, is confined to dry situations, and grows even in the clefts of rocks. By no means so common as *W. apetala*, its areal distribution is much the same. There are specimens in the collection from Dolga Bay; Cape Greben; islands in Kostin Shar; and from Ziwolka Fjord, 74° 25′, a very considerable extension of its previously recorded northern range in this area.

31. **STELLARIA LONGIPES** Goldie. A very common plant over the entire area visited. Habarova; Dolgoi Island; Cape Greben; Cape Matiusela; Neckwatowa; Goose Land; Nameless Bay; Gubina Bay; Beluga Bay, Lütke Land; Ziwolka Fjord.

32. S. **HUMIFUSA** Rottb. This appears to be entirely a maritime plant, growing in spots where there is a suspicion of sea-water rising over the land at times. I found it not uncommon on Dolgoi Island, the shores of Waigats, and Goose Land of Novaya Zemlya; not extending to or overlooked by me in Lütke Land.

33. **CERASTIUM ALPINUM** L., formæ *lanatum*, *hirsutum* et *cæspitosum*. An abundant and generally dispersed plant, from the mainland of Arctic Russia to the northernmost point visited in Lütke Land. The three tolerably distinct

PLATE 81.



F. 11. 1 *S.* 3 *f.m.* 12-7-97.

VERATRUM ALBUM.

CAPE GREBEN, WAÏGATCH.

forma, to which the many specimens brought back are referred, are not confined to any particular area, but intermingle; it would be difficult to decide which is the predominant type. Specimens from Dolgoi Island are considered f. *hirsutum* Koch, from Habarova f. *cæspitosum* Malmgren; whilst from the Pachtussow Islands we get f. *hirsutum*, and from Ziwolka Fjord, 74° 25′, both *cæspitosum* and *lanatum* Wg. The various localities on Waigats, Novaya Zemlya, and Lütke Land, from which specimens of the different forms were brought, are too numerous to record.

34. **Alsine biflora** L. Rare or else overlooked by me. In my collection it appears only from the south coast of Waigats, from Neckwatowa, and from Beluga Bay, Lütke Land, at an altitude of 100 feet.

35. **A. imbricata** C.A.M. An addition to the flora of the Novaya Zemlya group. Found in only one locality, but there in considerable quantity—the east side of Beluga Bay, Lütke Land, in a broad watercourse at an altitude of 100 feet. This plant has long fibrous roots, stretching several feet amongst the sand and under the stones, and without this faculty of anchoring itself the plant could not exist where we found it, for in the first part of the thaw the flat of the watercourse must be covered with a deluge of snow, and water, and hurtling rocks. I noticed that many of the plants had been washed out, in spite of their immense development of root. The flower measures three-quarters of an inch across.

36. **A. rubella** Wahlenb (*Arenaria verna* L.). A not uncommon plant, generally growing on dry and exposed spots. Cape Greben; Dolga Bay; Nameless Bay, 200 feet; and Beluga Bay, Lütke Land, 100 feet.

37. **Arenaria ciliata** L. A common plant on Dolgoi Island, around Habarova, and near the sea-shores of Waigats, especially affecting the summits of wind-tortured islets, where amongst the splintered slates it grows in little bosses covered with white bloom, along with a few scattered plants of *Cerastium*, *Artemisia borealis*, *Papaver*, and *Eritrichium*. Found on Goose Land of Novaya Zemlya, but not included in my collections from Lütke Land.

38. **A. peploides** L. On the sea-shore in the neighbourhood of Habarova, and at Cape Voronoff, on the north of Waigats. Not included in my collections from Novaya Zemlya or Lütke Land, though found by Mr. Theodor Holm on the south coast of Meshdusharsky Island.

39. **Sagina nivalis** Fries. Only brought by me from one locality, Nameless Bay, 100 feet; probably overlooked at other stations.

40. **Hedysarum obscurum** L. An abundant plant on Dolgoi Island, equally so on the tundra around Habarova; generally distributed over Waigats in suit-

able spots, preferring dry ground and sheltered places under the lee of rocks. Islands in the lake of Neckwatowa; islands in Kostin Shar. On August 10th I found it growing abundantly and in full flower at Silver Bay, Lütke Land.

41. ASTRAGALUS ALPINUS L. A very commonly dispersed plant over Waigats, Novaya Zemlya, and Lütke Land. In flower at Ziwolka Fjord, 74° 25′ N., on August 7, 1897.

42. A. FRIGIDUS A. Gray (*Phaca frigida* L.), forma *littoralis* Hook. Not rare around Habarova, but not met with on Dolgoi Island. Abundant on Waigats, where it grows in dry and sheltered spots from the sea-shore to the summit of the ridges, 250 feet. In Novaya Zemlya, common around the lake of Neckwatowa, and on islands in Kostin Shar. In Lütke Land, around Beluga Bay, from shore-line to 100 feet.

43. OXYTROPIS CAMPESTRIS D. C. var. *sordida* Willd. A universally distributed plant over Waigats, Novaya Zemlya, and Lütke Land. It affects dry situations. Plentiful and in flower on the Pachtussow Islands, August 6th, and in Ziwolka Fjord, August 7th.

44. RUBUS CHAMÆMORUS Willd. Common on peaty soil around Habarova, also on Dolgoi Island. Grows in profusion in peaty ground on the tundra of Waigats. Obtained in South Goose Land, but not observed by me in Lütke Land.

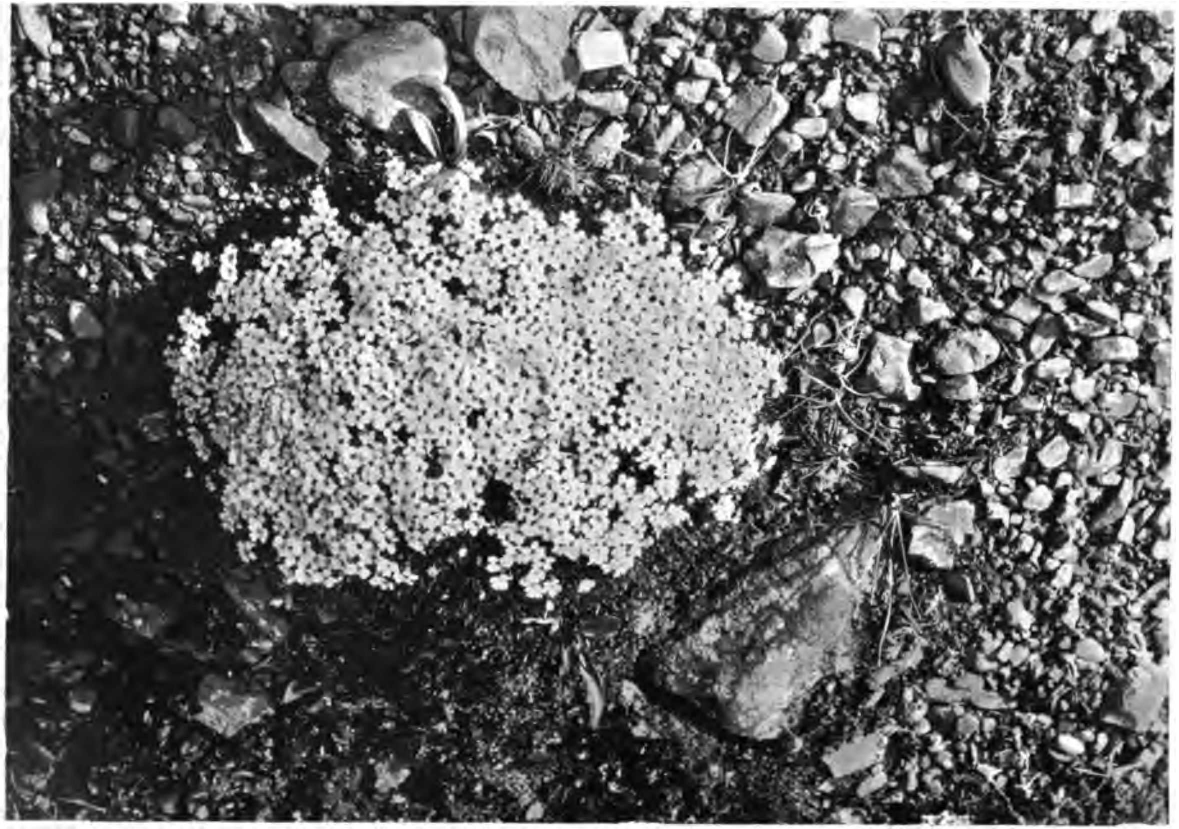
45. COMARUM PALUSTRE L. Neighbourhood of Habarova. Common around meres on the island of Dolgoi; also on Waigats, but not observed by me in Novaya Zemlya or Lütke Land.

46. POTENTILLA FRAGIFORMIS Willd. This is a widely spread and common plant, extending from the shores of the mainland of Arctic Russia to the farthest north reached in Lütke Land. Habarova; Dolga Bay; Neckwatowa; Rogatcheva Bay; islands in Kostin Shar; Nameless Bay; Beluga Bay, Lütke Land; and Ziwolka Fjord.

47. P. PULCHELLA R. Br. (*P. sericea* Graham non L.). Only appears in the collection from Beluga Bay, Lütke Land; altitude 100 feet.

48. P. NIVEA L. An addition to the flora of Novaya Zemlya; only identified and gathered at one station, namely, Gubina Bay, where it grew abundantly at an altitude of 300 feet, the plants attaining a height of eight inches.

49. DRYAS OCTOPETALA L. One of the most common of plants, and generally distributed. Very abundant on Dolgoi Island; all over Waigats, from the sea-shore to the highest ridges; common around Habarova; all over Novaya Zemlya and Lütke Land; found flowering on the Pachtussow Islands, 74° 24′ N., on August 6, 1897.



F. 64. 15 *S.* 4 55 *p.m* 28-7-97.

SILENE ACAULIS.

BELUSHJA BAY, LÜTKE LAND.

50. Hippuris vulgaris L. Common in meres on Dolgoi Island; also at Cape Voronoff, Waigats, but not observed by me in Novaya Zemlya or Lütke Land.

51. Saxifraga oppositifolia L. This universally distributed Arctic plant is not so abundant as in some parts of the Polar world, notably Grinnell Land. However, it shares with three other plants, viz., *Papaver nudicaule*, *Cerastium alpinum*, and *Dryas octopetala* var. *integrifolia*, the position of growing in the most northern land yet reached by man, having been obtained at Lockwood Island, 83° 24′ N., by Lieut. Lockwood of the Greely Expedition. By no means common on Dolgoi Island; found in the neighbourhood of Habarova; generally distributed over Waigats, among rocky areas; the same in Novaya Zemlya; not uncommon about Beluga Bay, Lütke Land, where it reached an altitude of 850 feet; on the Pachtussow Islands, 74° 24′ N.

52. S. flagellaris Willd. Not observed on Dolgoi Island, nor on the tundra of the mainland of Russia around Habarova. Though carefully looked for, not observed by me on the island of Waigats. In Novaya Zemlya it is a commonly distributed plant, likewise over Lütke Land. In the neighbourhood of Beluga Bay, 73° 20′ N., this plant grew with great vigour on gravel beaches at 100 feet altitude, the diameter covered by the radiating stolons of individual plants measuring as much as nine and ten inches. It grows abundantly on the Pachtussow Islands, 74° 24′. It is among the plants that extend their range nearest to the Pole, and I found it to be one of the commonest in Grinnell Land between the 82° and 83° N. lat.

53. S. aizoides L. Common on Dolgoi Island, found in the neighbourhood of Habarova, local but abundant on Waigats, the same in Novaya Zemlya and Lütke Land. Habarova; Dolgoi Island; south shore of Waigats; Nameless Bay; Beluga Bay, Lütke Land, and Silver Bay.

54. S. Hirculus L. This is the most widely distributed and commonest plant of the regions visited. On Dolgoi Island it is so abundant as to give a yellow tinge to the tundra-land; plentiful around Habarova; the greater part of the island of Waigats is dotted over with it, and this is often the case in Novaya Zemlya and Lütke Land. It was found in flower and very abundant on the Pachtussow Islands and in Ziwolka Fjord.

55. S. stellaris L. forma *comosa* Poir. Common on Dolgoi Island and around Habarova; generally distributed over Waigats, from the shore to the highest ridges; very common in Novaya Zemlya and Lütke Land; abundant on the Pachtussow Islands.

56. S. nivalis L. Not observed by me on Dolgoi Island. May have been

overlooked. It is common around Habarova, generally distributed over Waigats and Novaya Zemlya; also in Lütke Land, where it grows up to elevations of over 800 feet. It was found growing vigorously on the Pachtussow Islands.

57. S. HIERACIIFOLIA W. et K. This plant is by no means so abundant as several of the other Saxifrages. It is seldom if ever met with in beds, but springs up in individual stems at intervals; it is, however, very extensively distributed. Met with on Dolgoi Island, around Habarova, over Waigats (where plants were gathered up to twelve inches in height), over Novaya Zemlya and Lütke Land; the most northerly station where it was observed being Ziwolka Fjord, 74° 25′ N.

58. S. CERNUA L. A widely distributed plant over the entire area under review. Common on Dolgoi Island, the same over the tundra around Habarova; on Waigats, from the shore-line to 200 feet; all over Novaya Zemlya. Remarkably fine specimens were met with at Gubina Bay, at an altitude of 100 feet, the blossoms measuring 1¼ in. in diameter. It was found on the Pachtussow Islands, and in flower and growing luxuriantly in Ziwolka Fjord.

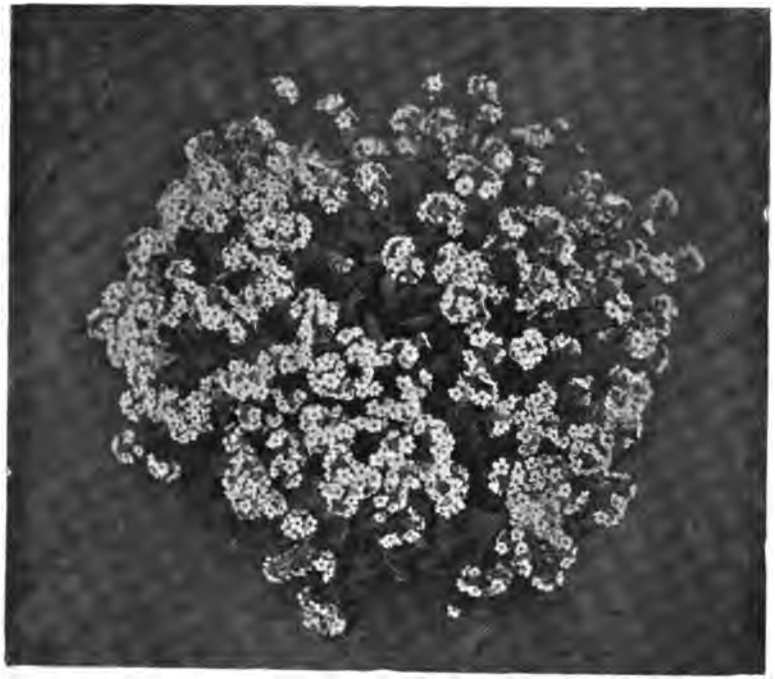
59. S. RIVULARIS L. Dispersed over Waigats and Novaya Zemlya, and Lütke Land; found in flower at Ziwolka Fjord. This herb varies much in growth. In suitable localities by the side of rills it attains to a height of two or three inches, but by the sea-shore it contracts to diminutive proportions, almost microscopic; under the lens, however, they show themselves to be mature flowering plants. The root-growth of this variety likewise differs from the normal plant.

60. S. CÆSPITOSA L. forma *decipiens* Ehrb. Common on Dolgoi Island and around Habarova. A conspicuous plant in Waigats, especially near the sea-shore and on the deltas at the mouths of streams; there it may be seen growing in bosses, with hundreds of blooms springing up together to a height of 2½ in. to 3 in., the colour of the flowers varying from white to rich lemon-yellow. It is generally distributed over Novaya Zemlya; at Beluga Bay, Lütke Land, it was found growing at an altitude of 850 feet, but in a diminutive form; likewise obtained on the Pachtussow Islands.

61. CHRYSOSPLENIUM ALTERNIFOLIUM L. A common plant in swampy places on Dolgoi Island; the same around Habarova; likewise over Waigats and Novaya Zemlya. The most northern station where it was observed by me is Beluga Bay, Lütke Land, where it grew up to an elevation of 300 feet.

62. PARNASSIA PALUSTRIS L. var. *alpina* Drude. I met with this plant in some abundance on the west shore of Dolgoi Island, and again on the south

PLATE 83.



F. 11. 3 *S.* 3.10 *p.m.* 1-8-97.

MYOSOTIS ALPESTRIS.

BELUSHJA BAY, LÜTKE LAND.

shore of Waigats, to the east of Cape Greben. In both places the plants grew in peaty soil.

63. Sedum Rhodiola D. C. Common on rocks near the sea-shore on Dolgoi Island. The same on Waigats, extending from the shore-line to the highest elevations. Found on islands in Kostin Shar, Neckwatowa, Besemannya Bay, Silver Bay, Beluga Bay, Matyushin Shar.

64. Epilobium palustre L. Common in the neighbourhood of Habarova, in marshy spots on the island of Dolgoi, and in Waigats.

65. E. alpinum L. South side of the Matyushin Shar in the Farassowa Valley, at an elevation of 250 feet.

66. E. latifolium L. I did not find this plant in Waigats, but it is common enough in Novaya Zemlya. I found it on islands in the lake of Neckwatowa. It is extremely abundant in some of the valleys descending on both sides to the Matyushin Shar. It seems to flourish in dry watercourses, its roots bedding deeply amongst the stones and boulders. It must needs have a very secure root-hold, for when the snow first melts these watercourses are filled with raging torrents, which sweep over the plants. I noticed a cliff in the valley of Gubina Bay clad with this *Epilobium* to a height of 100 feet. It was growing by the acre round Beluga Bay of Lütke Land, and in full flower by July 31, 1897.

67. Pachypleurum alpinum Ledeb. Common around Habarova, wide-spread over Waigats, but seeking shelter under the lee of rocks. On Novaya Zemlya, at Neckwatowa, and islands in Kostin Shar. Not observed by me in Lütke Land.

68. Valeriana capitata Pall. Is a common plant on the tundra around Habarova. I found it rare on Dolgoi Island, generally dispersed over Waigats, common in Novaya Zemlya; at Neckwatowa, over Goose Land at Besemannya Bay, where I gathered examples nine inches in height; and, though growing in profusion at various localities on the south shore of Matyushin Shar, I do not remember meeting with it on the north side of that strait. Anyhow, there is no example in my collections from Lütke Land.

69. Pyrethrum bipinnatum Willd. Not uncommon around Habarova. On Waigats, growing in sand near the sea; at Cape Voronoff; and at Cape Matiusela, on the east coast. Not met with by me in Novaya Zemlya.

70. Matricaria inodora L. var. *phæocephala* Rupr. Grows near the sea-shore at Habarova; in great profusion at Waigats; around Dolga Bay of that island the strand just above high-water line was carpeted with this plant; abundant at Cape Greben. In Novaya Zemyla met with at Neckwatowa.

71. ARTEMISIA BOREALIS Pall. I did not observe this plant on the mainland around Habarova, but it is common on Waigats, from the shore-line to 100 feet; it grows in the most exposed situations. It is common enough in Novaya Zemlya, where I found it at Neckwatowa and Besemannya Bay. At Beluga Bay, Lütke Land, it was likewise abundant.

72. A. VULGARIS var. *Tilesii* Ledeb. A common enough plant on the mainland around Habarova. All over Waigats, common in Novaya Zemlya, and at Beluga Bay of Lütke Land.

73. SENECIO RESEDIFOLIUS Less. Not uncommon on the mainland around Habarova. Met with on Waigats near Cape Greben, and at Dolga Bay. Not observed by me in Novaya Zemlya.

74. S. FRIGIDUS Less. Common around Habarova. Very abundant on peaty lands all over Waigats, its bright large yellow blossoms being quite a feature. I did not observe it in Novaya Zemlya.

75. S. CAMPESTRIS D. C. var. *integrifolius* Hook. Not uncommon on Dolgoi Island, the same around Habarova, and quite common over the south part of Waigats. I did not come across it in Novaya Zemlya.

76. ANTENNARIA CARPATHICA Br. Met with around Habarova, and sparsely both at the north and south of Waigats.

77. ERIGERON UNIFLORUS L. Though hardly to be termed a common plant, it is to be found here and there on Waigats, where it affects sheltered ledges amongst rocks. I found it on islands in the lake of Neckwatowa, at Gubina Bay, and not uncommonly around Beluga Bay of Lütke Land.

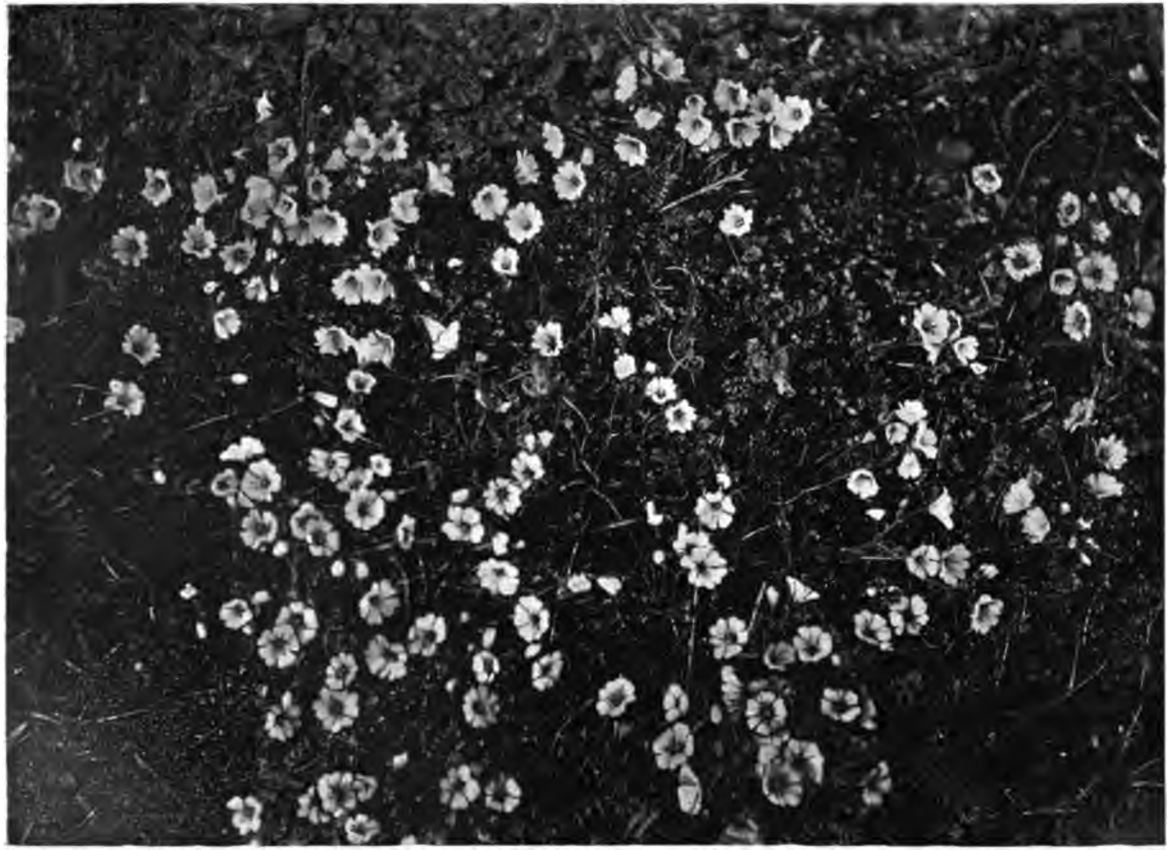
78. PETASITES FRIGIDA Fr. Met with in considerable quantity on Dolgoi Island, where the stalks of the plant were over a foot high; at the time of my visit (July 20th) it was out of flower. Abundant around Habarova. It is a common enough plant in suitable localities, namely, wet bogs over Novaya Zemlya; gathered it in flower on Goose Land, July 26, 1895. North of the Matyushin Shar, in Lütke Land, though I frequently met the plant, I never found it with the least sign of inflorescence.

79. TARAXACUM OFFICINALE Web. Met with around Habarova. Common over Waigats, Novaya Zemlya, and Lütke Land.

80. T. PHYMATOCARPUM J. Vahl. Is a much scarcer plant than the preceding, and markedly different; its petals are delicately suffused with pink. I found it at Neckwatowa, and on islands in Kostin Shar, at Gubina Bay, and in Lütke Land as far north as Ziwolka Fjord in 74° 25′ N.

81. CAMPANULA UNIFLORA L. On Waigats I found it growing in considerable quantity on a rocky slope some 50 feet above sea-level at Dolga Bay. It was in

PLATE 84.



F. 11, 1 *S.* 5.20 *p.m.*

31-7-97.

CERASTIUM ALPINUM

BELUSHJA BAY, LÜTKE LAND.

flower on July 8th. I met with it afterwards at Besemannya Bay, and at Beluga Bay of Lütke Land; also at other stations on the north side of Matyushin Shar.

82. Pyrola grandiflora Raddi. During the first week of July a *Pyrola* not in flower was common around Dolga Bay of Waigats. In the middle of July I found more in the same condition at Beluga Bay of South Goose Land; but on July 31st I was fortunate enough to obtain a *Pyrola* at Beluga Bay of Lütke Land, coming into flower. This has been pronounced to be *P. grandiflora* without doubt. (Mr. I. H. Burkill remarks: "On dissecting a bud, the stigma will be found to be that of this species.")

83. Arctostaphylos alpina L. I met with it at an elevation of 150 feet at the north end of Waigats. Though recorded from Novaya Zemlya, from between the parallels of 72° and 73°, it is an addition to the flora of Waigats.

84. Vaccinium Vitis-idæa L. forma *pumila* Horn. Common on Dolgoi Island, the same on the mainland around Habarova. Spread all over Waigats, from an altitude of 50 feet to highest points; in flower end of June and beginning of July. Met with at Neckwatowa and Beluga Bay of South Goose Land, but not observed by me in Lütke Land.

85. V. uliginosum L. Met with at the north end of Waigats, at an elevation of 150 feet. In Novaya Zemlya it only occurred to me at Gubina Bay and Matyushin Shar, at an elevation of 200 feet.

86. Cassiopeia tetragona L. I was interested in finding this plant, one of the commonest on the island of Dolgoi. It has not been met with on Waigats or Novaya Zemlya, but as Schrenk found it on the Great Tundra of the Samoyeds, almost at the nearest point to Dolgoi Island, its extension thereto was to be expected.

87. Andromeda Polifolia L. Very common on dry peaty knolls over the island of Dolgoi. The remarks on distribution of the preceding species apply equally to *A. Polifolia*.

88. Primula stricta Horn. The *Primula* I found on Dolgoi Island belongs to this species.

89. P. farinosa L. This is a very common plant on Waigats, from south to north; always found near the sea-shore in peaty soil. It is such a pretty flower, and so attractive, that I gathered hundreds of the blooms, and brought back scores of dried specimens, but all seem to be *P. farinosa*. In Novaya Zemlya I met with it at Neckwatowa and Beluga Bay of Goose Land. I did not meet with it north of the Matyushin Shar.

90. Androsace Chamæjasme Koch. Common on the mainland around

Habarova. All over Waigats, from the sea-shore to the highest summits. I did not meet with it in Novaya Zemlya.

91. A. TRIFLORA Adams. I found this plant at Neckwatowa in July 1895, and growing abundantly at an elevation of some 500 feet at Besemannya Bay in August 1897. I submitted specimens to Mr. O. Gelert, of the Royal Botanical Gardens, Copenhagen, and he informed me:—"The *Androsace* you kindly sent is *A. triflora* Adams; specimens in a young flowering state are in our Arctic herbarium from Besemannya Bay, collected by Kjellman and Lindström, and are exactly the same as your plant."

92. CORTUSA MATTHIOLI L. This lovely little flower I only found at one spot on Waigats, namely, at the head of Dolga Bay, on July 4, 1897.

93. ARMERIA SIBIRICA Turcz. Common on dry knolls over the island of Dolgoi. On the mainland around Habarova. Frequently met with on Waigats, from Cape Greben, and Dolga Bay. I found it in profusion and in beautiful bloom at Silver Bay, Lütke Land, on August 10, 1897.

94. POLEMONIUM CÆRULEUM L. forma *acutifolia* Willd. Perhaps the most beautiful of all the flowers of these regions. The lovely cærulean blue of the blossoms and its tall growth and abundance in certain spots make it a very attractive plant. On Dolgoi Island it is abundant, growing in damp spots by sides of runnels. It is equally abundant on the mainland around Habarova. All over Waigats. At Dolga Bay it grew in suitable damp localities from the sea-shore to 100 feet of altitude; very abundant at Cape Greben, and on the east coast at Cape Matiusela. At Cairn Harbour (Pomorsky Bay) it grew luxuriantly, specimens attaining a height of a foot or more, and the same around Beluga Bay of Lütke Land.

95. P. PULCHELLUM Bunge. I have some doubt whether this plant is specifically distinct from *P. cæruleum*. I have examined hundreds of specimens from the same cluster of plants. Typical *P. cæruleum* would be found growing a foot high, with its roots in the water of some rill; as the plants spread upwards, where the banks are higher and drier, they changed into what we call *P. pulchellum*, but with every phase of intergrading. The following appeared to me the fact: that *P. cæruleum* always grows in wet and damp spots, *P. pulchellum* on dry spots. I did not meet with typical *P. pulchellum* on Waigats, but found it abundantly dispersed over Novaya Zemlya, from islands in the lake of Neckwatowa, South Goose Land, Besemannya Bay, and Gubina Bay; on Lütke Land, at Beluga Bay, and as far north as Ziwolka Fjord, 74° 25′.

96. MYOSOTIS ALPESTRIS Koch. Occurs on Dolgoi Island and on the main-

land around Habarova. Abundantly dispersed all over Waigats. The flowers are of many shades of blue, sometimes pink, more rarely white. It is equally common all over Novaya Zemlya. On Lütke Land I found it common, and as far north as the Pachtussow Islands and Ziwolka Fjord.

97. **Eritrichium villosum** Bunge. Abundant over Waigats, Novaya Zemlya, and Lütke Land. Found on the the Pachtussow Islands and Ziwolka Fjord. It seems to flourish best upon the bleakest islets near the shore; there this plant appears in little bosses of the most brilliant turquoise-blue, offering a most astonishing contrast to the shattered brown stones which form the surface. This plant is gynodiœcious in Novaya Zemlya, the hermaphrodite flowers being considerably larger than the female.

98. **Gentiana tenella** Fries. Quite typical. Met with in considerable quantity growing in peaty soil on the west side of Dolgoi Island. Found on the south side of Besemannya Bay, at an elevation of 150 feet. This plant is an interesting addition to the flora of Novaya Zemlya. It is recorded from Spitsbergen.

99. **Veronica alpina** L. It was somewhat of a surprise to find this alpine plant growing in close proximity to the sea, at about 20 feet elevation, some three miles to the west of Habarova. It has not hitherto been recorded from Yugor Straits or the north coast of Siberia.

100. **Pedicularis lapponica** L. On Dolgoi Island I found it growing sparingly on dry hillocks. Did not observe it in the neighbourhood of Habarova. On Waigats I met with it near Cape Greben, and also at the north end of the island, where it grows on the higher ridges. It is an addition to the flora of Waigats.

101. **P. Oederi** Vahl. I met with this plant only at Dolga Bay, island of Waigats, where it grew in great profusion over the tundra swamps, its large citron-yellow blossoms being very conspicuous and effective. Personally I have found little variation in the colour of the blossoms, but the experience of others is decidedly contrary to mine. Mr. Burkill has drawn my attention to the following. Wahlenberg, in proposing the name *versicolor*, does so in the following words (De Veget. et Clim. Helvetiæ Septentr. p. 118):—"Galea tantum sub apice coccineo-maculata, macula exsiccando evanescente. . . . Nomine supra dato colorem fugacem simulque duplicem indicare volui." Thus he gives the name because the colour in Swiss specimens changes to pink below the top of the hood, and also fades in drying. But the plant varies in different localities, so that Bentham (DC. Prod. x. 578) says:—"Flores citrini vel unicolores vel galea sub apice rubra vel purpurea." My plants are of the first alternative

Bentham also adds that the proportional size of the hood varies in Arctic, Siberian, and European examples.

102. P. HIRSUTA L. This small lousewort is extremely common all over Waigats, growing in dry spots from the shore-line to the highest ridges, say 250 feet. I met with it in abundance at Neckwatowa, over Goose Land, and many other stations. It is common enough on Lütke Land, in the neighbourhood of Beluga Bay, and the Matyushin Shar; it was common on the Pachtussow Islands, and found sparingly in Ziwolka Fjord. The plants which I have gathered in Spitsbergen agree precisely with Novaya Zemlya specimens.

103. P. SUDETICA Willd. There are two very distinct forms included under this name. Both affect the same localities—damp, water-sodden tundra; they both abound on Waigats, and give a bright appearance to the areas over which they are spread. One form has a deep pink blossom and a dark stem, with very little wool about the blossom-head. The other form has blossoms of a very delicate pink shade, the stem light green, and a great deal of wool at the base of the blossom. The deep pink form with little wool I met with on Dolgoi Island, around Habarova, commonly on Waigats, and over Novaya Zemlya, and at Beluga Bay of Lütke Land. The light pink form with much wool I gathered on Waigats, Goose Land, and likewise on Lütke Land, at Beluga Bay. I presume these are the forms of *P. sudetica* described as formæ *gymnocephala* Trautv. and *lanata* Walp.

104. P. LANATA Willd. f. *dasyantha* Trautv. This plant grows in the wet tundra alongside of *P. sudetica;* the blossoms are of a bright rosy hue, and the flowering head is thickly clad with wool. I met with it in abundance on Waigats, and around Neckwatowa, in Novaya Zemlya.

105. PLANTAGO MARITIMA L. f. *pumila* Kjellm. Met with in some abundance on Dolgoi Island and near Cape Greben, Waigats.

106. POLYGONUM BISTORTA L. A common plant on Dolgoi Island, around Habarova, and spread over Waigats from north to south. Not observed by me in Novaya Zemlya.

107. P. VIVIPARUM L. A ubiquitous plant. Abundant on Dolgoi Island, and around Habarova, all over Waigats, Novaya Zemlya, and Lütke Land, along the shores of Matyushin Shar, Beluga Bay, and Pachtussow Islands, and Ziwolka Fjord, where I met with specimens five inches in height.

108. RUMEX ARCTICUS Trautv. I only found this plant on the south shore of Waigats and at Cape Matiusela, on the east coast of that island.

109. R. ACETOSA L. South shores of Waigats, Goose Land, and Besemannya Bay of Novaya Zemlya.

110. **Oxyria digyna** Hill. Universally distributed over Waigats, Novaya Zemlya, and Lütke Land, as far north as reached by me, viz. 74° 25′, on the east coast.

111. **Koenigia islandica** L. Found in considerable abundance at various stations around Beluga Bay of Lütke Land, and along the north side of the Matyushin Shar; and at Besemannya Bay.

112. **Empetrum nigrum** L. Common on Dolgoi Island. Met with at Cape Matiusela, east coast of Waigats; an addition to the flora of that island.

113. **Betula nana** L. Common on Dolgoi Island; the same over Waigats; rarer in Novaya Zemlya. I do not remember observing it north of the Matyushin Shar; anyhow, there is no example of it from Lütke Land in my collection. The stem of an apparently old plant from Waigats shows sixty annual rings.

114. **Salix polaris** Wahlenb. Abundant over Waigats, Novaya Zemlya, and Lütke Land, where it was obtained as far north as the Pachtussow Islands.

115. S. **rotundifolia** Trautv. Dolgoi Island; Cape Matiusela, Waigats; Silver Bay, Lütke Land.

116. S. **reticulata** L. Dolgoi Island; Habarova; Waigats; Novaya Zemlya; Silver Bay, Lütke Land.

117. S. **arctica** Pall. type, and var. *Brownei* Anderss. Dolgoi Island; all over Waigats, Novaya Zemlya, and Lütke Land, extending to the Pachtussow Islands. A stem of this plant from Lütke Land shows twenty-nine annual rings, but one which I gathered in Grinnell Land in 82° 45′ N. lat., the most northern latitude from which a willow has been recorded, has forty annual rings.

118. S. **glauca** L., with var. *subarctica* Lundstr. Only appears in the collection from Waigats, where it is quite common.

119. S. **reptans** Lundstr. From the south shore of Waigats.

120. S. **tajmyrensis** Trautv. From Beluga Bay and Silver Bay of Lütke Land.

121. S. **lanata** L. × S. **glauca** L. Dolga Bay, Waigats. (Apparently a hybrid of these two species, with which it was growing, I. H. Burkill.)

122. S. **myrsinites** L. Dolgoi Island and Dolga Bay, Waigats.

123. **Tofieldia palustris** Huds. Dolgoi Island.

124. **Allium sibiricum** L. Common on Dolgoi Island, around Habarova, and at Cape Greben, and along the south shores of Waigats.

125. **Lloydia serotina** Reichenb. An abundant plant from north to south of Waigats, Cape Greben, Cape Matiusela, Dolga Bay. In flower last week of June 1897.

126. Veratrum album L. Common along the banks of the Nikolski River, and in dry-stream beds around Habarova. I found it growing in abundance at the head of a bay on the east of Cape Greben, on the south shore of Waigats. It there attained a height of three feet, and was in flower on July 12, 1897. An addition to the flora of Waigats.

127. Juncus castaneus Sm. Habarova; Cape Greben, Waigats; and Neckwatowa, Novaya Zemlya.

128. J. biglumis L. Generally distributed. Dolgoi Island, Habarova, Waigats, Novaya Zemlya, and over Lütke Land as far as the Pachtussow Islands. A very variable plant in size; there are specimens in the collection from Silver Bay eight inches in height.

129. Luzula Wahlenbergii Rupr. Dolgoi Island, and Habarova, Cape Greben, Dolga Bay, Goose Land.

130. L. confusa Lindeb. Cape Matiusela; Dolga Bay, Waigats; Rogatchiva Bay; Neckwatowa; Goose Land; Pomorsky Bay; Gubina Bay; Beluga Bay of Lütke Land, up to 850 feet altitude; Pachtussow Islands and Ziwolka Fjord.

131. L. arctica Blytt. Dolgoi Island; Habarova; Besemannya Bay.

132. Eriophorum angustifolium Roth. Dolgoi Island; Habarova; south shores of Waigats; Neckwatowa; Beluga Bay of Lütke Land.

133. E. vaginatum L. Cape Matiusela; Neckwatowa; Goose Land; Pomorsky Bay; Gubina Bay; Beluga Bay of Lütke Land.

134. E. Scheuchzeri Hoppe. Dolgoi Island; Cape Matiusela; Dolga Bay; Neckwatowa; Besemannya Bay; Beluga Bay of Lütke Land.

135. E. Callithrix Cham. Dolgoi Island; Habarova; Cape Greben; south shores of Waigats; Beluga Bay of Lütke Land.

136. E. russeolum Fries. Dolgoi Island; Habarova; south shores of Waigats.

137. Carex pulla Good. Habarova; Dolga Bay; Silver Bay.

138. C. rotundata Wahlenb. Dolgoi Island; Habarova; south shores of Waigats.

139. C. fuliginosa Schk. (*C. misandra* R. Br.). Dolgoi Island; Habarova; Dolga Bay; Besemannya Bay; south side, Matyushin Shar; Beluga Bay of Lütke Land; Silver Bay.

140. C. rariflora Sm. Dolgoi Island; Habarova; south shores of Waigats; islands in Kostin Shar.

141. C. salina Wahlenb. f. *subspathacea* Wormskj. South shores of Waigats; Pomorsky Bay; Matyushin Shar.

142. C. AQUATILIS Wahlenb. Habarova; south shore of Waigats; Cape Greben; Dolga Bay; Gubina Bay; Neckwatowa; Beluga Bay of Lütke Land.

143. C. RIGIDA Good. Dolgoi Island; south shores of Waigats; Dolga Bay; Kostin Shar; Besemannya Bay; Pomorsky Bay; north side Matyushin Bay; Beluga Bay of Lütke Land.

144. C. GLAREOSA Wahlenb. Dolgoi Island; Habarova.

145. C. LAGOPINA Wahlenb. South shores of Waigats.

146. HIEROCHLOE ALPINA R. & S. This is a common grass scattered over Waigats, Novaya Zemlya, and Lütke Land. It generally occurs in tufts and bunches on dry ground, and from its straw colour and the glistening of the glumes attracts attention. Dolga Bay, Rogatchiva Bay, Beluga Bay, Matyushin Shar, and common at Ziwolka Fjord, 74° 25′ N.

147. H. PAUCIFLORA R. Br. I find it common in the collection from South Goose Land and Neckwatowa. Probably overlooked by me at other stations.

148. ALOPECURUS ALPINUS Sm. Not very common; obtained at Habarova, Cape Matiusela, Besemannya Bay, Gubina Bay, Pachtussow Islands.

149. A. PRATENSIS L. var. *alpestris* Wahlenb. Waigats.

150. AIRA CÆSPITOSA Beauv. With its vars. *alpina* and *brevifolia* is widely distributed over Waigats, Novaya Zemlya, and Lütke Land. I found it not uncommon on the Pachtussow Islands.

151. CALAMAGROSTIS NEGLECTA Gaertn. Common along the south shore of Waigats. I gathered it again in Pomorsky Bay, Matyushin Shar. Mr. Burkill writes:—"With regard to the *Calamagrostis*, I have come to the following conclusions: that habit and acuteness of the glumes are the characters on which mainly to rely. I cannot separate *Calamagrostis Holmii* specifically from *C. neglecta*, and should place the Arctic forms as follows:—*C. neglecta* (*Deyeuxia neglecta* Kunth). The type is the well-known plant of North-Western and Central Europe and Siberia. It is a plant from two to three feet high. Var. *borealis* Laestad., Lange, *Conspectus Fl. Groenlandicæ*, p. 161: a low plant with acute glumes. Var. *Holmii* (*Calamagrostis Holmii* Lange): of the same habit as the last, but perhaps more densely tufted, differing chiefly in its somewhat acuminate glumes. This last we have from Spitsbergen, Axel Island (A. Trevor-Battye). The character which Lange drew from the position of the awn becomes useless; for, though in his type it is situate above the middle of the glume, in your specimens, which I am now quite satisfied are identical, it is sometimes at the middle, but more often below it." On the other hand, I submitted specimens from Waigats to Mr. Th. Holm, and he writes me from Washington, U.S.A.,

that he does not hesitate to identify the plant as *C. Holmii.* He remarks that the details of the spikelet and the characteristic coloration of the empty glumes in *C. Holmii* are also present in the specimen sent by me. *C. Holmii*, as described by Lange, was obtained originally by Mr. Holm on the mainland of Yugor Straits.

152. **Trisetum subspicatum** Beauv. Waigats, South Goose Land, Besemannya Bay, south shores of Matyushin Shar.

153. **Dupontia Fischeri** R. Br. A widely distributed grass; common on Dolgoi Island, around Habarova, Waigats, Novaya Zemlya, and Lütke Land.

154. **Colpodium latifolium** R. Br. A widely distributed plant. Habarova, Waigats, Novaya Zemlya, and Lütke Land.

155. **Phippsia algida** Br. and var. *P. concinna* Fries. There is a large series of this grass in my collection, all in flower, from Waigats, Novaya Zemyla, and Lütke Land, varying from a plant nine inches in height to a dwarf form of less than an inch. The tallest examples, var. *concinna*, come from Cape Matiusela, Waigats, the more dwarf from Lütke Land. It is not uncommon on the Pachtussow Island and Ziwolka Fjord.

156. **Pleuropogon Sabinii** R. Br. The known distribution of this grass is very remarkable. So far it has not been met with on the mainlands of the Old or New Worlds, but is confined to the islands of the Polar and Arctic regions and Greenland. First discovered by Sabine on Melville Island, 1819; it was subsequently met with by our Arctic explorers in several localities amongst the American Arctic Archipelago, notably by Dr. Walker, at Bellot Straits; by Dr. Lyall, at Powell Creek; and by Admiral Markham, at Fury Beach. It is apparently a common plant on the western side of Davis Strait, for Mr. James Taylor remarks (Trans. Bot. Soc. Edinb. vii. p. 333) that it grows from the coast-line to 200 feet in pools of water on any kind of soil. "It is perhaps the finest of Arctic grasses; its leaves float on the surface, the culm rising from nine inches to one foot above the water, bearing its beautiful purple florets." Found at Cumberland Gulf, Cape Searle, Scott's Bay, Cape Adair. Prof. Nathorst discovered it at Cape York, in North Greenland. It appears to be absent from Grinnell Land, for Mr. H. C. Hart failed to find it around Discovery Bay, or on the opposite Greenland shore of Smith Sound in 1875–76; and I was equally unsuccessful in finding any trace of it in Grinnell Land, between the eighty-second and eighty-third degrees; whilst the members of the Greely Expedition were not more fortunate. Turning to the eastern hemisphere, it was first recorded by Von Baer from Novaya Zemlya, 1837, and subsequently by various

other botanists from that group. The botanists of the Vega Expedition found it in Actinia Bay, Taimur Island, off the coast of Siberia; and Mr. H. Fisher has recently discovered it in the Franz Joseph Land group, but only at one spot, a small pond on Mabel Island. I found it growing abundantly in pools of water and damp situations on the western shores of Beluga Bay of South Goose Land, at Pomorsky Bay, abundantly at Silver Bay, at Gubina Bay, at many places on both sides of the Matyushin Shar, all around Beluga Bay of Lütke Land, where it grows from the shore-line to a height of 750 feet, and I met with it, but in a somewhat stunted form, at Ziwolka Fjord, 74° 25′ N. *P. Sabinii* is distinctly a water-growing grass; its long roots are firmly attached in the soil or mud, the leaves float on the water, and, as Mr. Taylor remarks, its purple inflorescence makes it quite conspicuous; it is certainly the most beautiful of all the Arctic grasses. It seems somewhat singular that such a common and generally dispersed plant over Novaya Zemlya and Lütke Land should have attracted so little attention. Can it be that the exceptionally fine summer of 1897 caused it to bloom more freely than usual? The tallest plants I gathered were from Pomorsky Bay, and are over a foot in length. *Pleuropogon Sabinii* is one of about half a dozen species not found outside the Arctic Circle. It was formerly held to be the only *genus* confined to Arctic limits, but three others of the genus have since been found in America.

157. KOELERIA CRISTATA Gaud. Cape Greben and Cape Matiusela, Waigats.

158. GLYCERIA VAHLIANA Fries. Only appears in my collection from Beluga Bay of Lütke Land, at an elevation of 100 feet.

159. ARCTOPHILA FULVA Nym. This is the tallest and most striking grass of the regions visited. On Dolgoi Island very abundant in meres and ponds, standing two and three feet above water, affording shelter for broods of ducklings and phalaropes, and water-loving species of birds. On the mainland tundra around Habarova very common; shallow meres and ponds scattered over the tundra are in July given a lively verdant green colour from the dense beds of this grass, and looking over the dull grey tundra from some slight elevation these bands and circles of green look like oases in the desert, and are quite a relief to the eye tired of gazing on a sad brown landscape. Common all over Waigats from Cape Greben to Dolga Bay; common at Pomorsky Bay, south side of the Matyushin Shar, but I did not come across it in Lütke Land. With reference to the nomenclature of this plant, I add the following note from Mr. I. H. Burkill, from which it appears that the *Arctophila*, so abundant on the Arctic Russian tundras, Waigats, Dolgoi, and likewise in Novaya Zemlya, is, in his opinion,

A. fulva Nym.:—"*Arctophila effusa* Lange, twice figured in the *Flora Danica* (tab. 2343 and tab. Suppl. 126), is not the common Arctic European plant which has sometimes passed with this name. The European plant, *A. fulva* Nym., does not deserve the name of *effusa* at all, and is fairly easily distinguished from the Greenland form in the greater density of its panicle. It also occurs in North America. At Kew we have your grass as *A. fulva*, collected by Kriwoscheja, and named as *A. effusa*, collected by Kjellman and Lundström."

160. **Poa pratensis** L. There are specimens in the collection from Waigats, and likewise from Ziwolka Fjord, Lütke Land.

161. **P. abbreviata** R. Br. Mr. Burkill determines this species from specimens obtained from various localities around Beluga Bay and Lütke Land; one of the stations is 800 feet in altitude.

162. **P. alpina** L. I am greatly indebted to Mr. Burkill for the immense trouble he has taken in working out the *Gramineæ* in my collection, consisting of many hundreds of specimens; according to his determinations, this species occurs on Dolgoi Island, common around Habarova, all over Waigats, over Novaya Zemlya, and Lütke Land.

163. **P. arctica** Br. Mr. Burkill unites *P. cenisea* All. and *P. stricta* Lindeb. with this species; according to his determinations, *P. cenisea* is the prevailing form; it occurs in my collections from Dolgoi Island; on Waigats plentiful from shore-line to 100 feet; Cape Greben; south shores of Waigats; Cape Matiusela; Dolga Bay, and northern shores. From Novaya Zemlya, South Goose Land, Kostin Shar, Besemannya Bay, Pomorsky Bay, Gubina Bay, all the south shores of Matyushin Shar, over Lütke Land as far north as the Pachtussow Islands and Ziwolka Fjord. *P. stricta* seems to be a far less common form.

164. **Festuca rubra** L. var. **arenaria** Osb. Gubina Bay, Besemannya Bay, and Pachtussow Islands.

165. **F. ovina** L. Habarova.—Subspecies *F. brevifolia* R. Br. Beluga Bay, Lütke Land, and Ziwolka Fjord.

166. **Equisetum arvense** L. Dolgoi Island; Habarova; all over Waigats in suitable localities; all over Novaya Zemlya in suitable localities; Beluga Bay and Lütke Land.

167. **Lycopodium Selago** L. Met with on Dolgoi Island, and common on Waigats.

168. **Cystopteris fragilis** Bernh. Dolga Bay, Waigats, Besemannya Bay, and head of Beluga Bay, Lütke Land, at an elevation of 500 feet.

CONCLUSIONS.

I venture to offer a few remarks based upon my observations of plant-growth over the area referred to in the preceding pages. Sir Joseph Hooker has long since pointed out that Lapland is by far the richest province of the Arctic regions, whilst Arctic Asia from the Gulf of Ob to Bering Straits contains by far the poorest flora of any on the globe. That great authority, though including Spitsbergen, Novaya Zemlya, and the Arctic countries west of the River Ob in the Lapland province, has shown that in that area there are two floras corresponding to the Arctic-Norwegian and Arctic-Russian, the latter commencing at the White Sea, and comparatively exceedingly poor in species, though containing some twenty that are not Lapponian. Mr. Philip Sewell has given us an excellent treatise on this subject[1] in his paper on the Flora of Lapland and the Yugor Straits, in which he vividly depicts the poverty of the Arctic-Russian province in comparison with the Lapponian, and he expresses the opinion that the low-lying land eastward from the White Sea affords no suitable foothold which would allow of eastward distribution along the same line of latitude, and that the difference in the physical nature of the region of the Yugor Straits and the greater cold thereabouts are evidently the chief causes which restrict the distribution. This no doubt is correct as far as it goes, but it may not be amiss to enter more fully into the physical differences which characterise the two regions of Lapponia and Arctic Russia. Lapland and the Kola Peninsula are mountainous or elevated regions, bearing on their surfaces the impress of glacio-terrene action. They appear to me as areas from which an ice-cap or mer-de-glace has but recently been removed, and we may assume that during the period of maximum Scandinavian glaciation Lapland and the Kola Peninsula were heavily clad with ice, and considerably raised above sea-level. Judging from what we now see in Greenland, Grinnell Land, Spitsbergen, and Franz Josef Land, we may reasonably infer that phanerogamic vegetation was not actually extirpated throughout Scandinavia and Lapland during the period of maximum ice accumulation.

The theory that a huge ice-cap at one period covered the entire Polar area entirely rests on assumption and hypothesis. If, as I surmise, Lapland during its ice-period retained a flora, even as much as now exists in Grinnell Land and the north of Greenland, between the parallels of 82° and 83°, that would on the retirement of the ice become an important factor in the dissemination of a flora over an area recently released from ice, whilst in all probability a more extensive flora lived through the Scandinavian ice-age than we now find in Grinnell Land. On the other hand, from the eastern side of the White Sea, as far at least as the bases of the Urals and Pai-hoi Mountains, between the Arctic Circle and the seventieth parallel, we see evidences of recent emergence from an ice-laden sea. Whether this marine transgression over a considerable part of Arctic Russia was contemporaneous with, or later than, the period of maximum ice-development in Scandinavia and Lapland, does not affect the conclusion that the emergence of this extensive area has been very recent, and this with severe climatic conditions must have greatly restricted the incoming of a migrating flora. I assume that in Lapland, on the retirement of the ice, many nuclei of vegetation were at hand; in Arctic Russia the recent floor of a retiring ocean offered a most inimical soil to an invading flora.

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[1] "Flora of Lapland and Yugor Straits," *Transactions of Edinburgh Botanical Society*, xvii. 444–481.

The evidences[1] at our command seem to be convincing that the tundra of Arctic Russia and the islands of Waigats, Novaya Zemlya, and Lütke Land were in recent times submerged many hundreds of feet below their level of to-day. Great as this submergence was, it does not follow that the higher mountains of Novaya Zemlya or of the North Island were involved, and if we discard the theory of a universal ice-cap, there is no reason to deny the possibility of survival of some ancient Arctic flora on those lands.

That the floras of Kolguev Island, Dolgoi Island, Waigats, Novaya Zemlya, and Lütke Land are in their main features identical with that of the adjacent Russian mainland is undoubted, and that the spread of their vegetation has been chiefly longitudinal from the southward seems to be true. But how are such peculiarities in dispersal as the following to be accounted for? *Saxifraga flagellaris*, a plant widely distributed over the Polar area, and otherwise restricted to the high mountain regions of the Himalaya, Altai, and Caucasus. Still more remarkable is the distribution of the Arctic grass *Pleuropogon Sabinii:* so far it has not been met with on the mainlands of the Old or New World, and yet it is a widely dispersed plant throughout the Polar regions. If the vegetation now existing in the Polar area be due solely to immigration from the south since the withdrawal of a glacial epoch, it is certainly strange why *P. Sabinii* has got back there without leaving a trace of its existence south of the Arctic Circle. It may not be out of place to draw a comparison between the plants growing in the most northern known parts of the earth and the floras of Spitsbergen and Novaya Zemlya.

The following thirty-two plants[2] represent the flora of Grinnell Land and islands to the north of Greenland between 82° and 83° 24′ N. It is the flora growing nearest the Pole, all other flowering plants having been gathered south of the eighty-second parallel:—

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[1] Feilden, *Geographical Journal*, xi. 357.

[2] They were gathered by the officers of the British Polar Expedition 1875–76, and the late Lieut. Lockwood, United States Army.

Ranunculus affinis.
R. nivalis.
Papaver nudicaule.
Cochlearia fenestrata.
Braya alpina.
Draba alpina.
D. hirta.
D. rupestris.
Wahlenbergia apetala.
Arenaria rubella.
Cerastium alpinum and var. *cæspitosum.*
Dryas integrifolia.
Potentilla nivea.
Saxifraga oppositifolia.
S. cernua.
Saxifraga flagellaris.
S. cæspitosa.
S. tricuspidata.
S. nivalis.
Epilobium latifolium.
Taraxacum officinale.
Salix arctica.
Polygonum viviparum.
Oxyria digyna.
Alopecurus alpinus.
Poa abbreviata.
Festuca ovina.
Eriophorum angustifolium
Juncus biglumis.
Carex nardina.
C. fuliginosa.

Of these, all but three—*Dryas integrifolia, Saxifraga tricuspidata,* and *Salix arctica*—occur in Spitsbergen, whilst only two are absent from Novaya Zemlya, namely, *Dryas integrifolia* (and in both countries the nearly allied *Dryas octopetala* takes its place), and *Saxifraga tricuspidata.*

If the lines of plant migration towards the North Pole emanate entirely from Europe, Asia, and America since the close of the glacial epoch, it is a remarkable coincidence that as these routes converge around the Pole from different sides of the hemisphere, the more characteristic plants of those regions of the earth become eliminated, and a nearly homogeneous flora is to be found on the lands nearest to the northern apex of the globe. Does not this give some colour to the hypothesis that a remnant of a palæarctic flora has been spared, and is represented by this more or less identical flora in the highest latitudes on different sides of the Pole? It may be urged, on the contrary, that the coincidence arises merely from these plants being better able to withstand severe climatic conditions.

I am satisfied that a large number of the plants of Waigats and Novaya Zemlya propagate from seed, so often did I meet with old plants surrounded by groups, to my mind, of undoubted seedlings; this is notable with *Cochlearia,* *Draba*, *Taraxacum*, *Papaver*, and a number of other species. This does not, however, invalidate the opinion that the flowering plants of Grinnell Land, some thirteen degrees nearer the Pole than Waigats Island, are not reproduced by seed, but that their extension is due to the creeping and spreading powers of the individual plants. This view has been forcibly advocated by Mr. H. C. Hart,[1] and my own observations in the same regions as he refers to, lead me to embrace similar conclusions.

	N. Lat.							
Fam. Ranunculaceæ.	76–77°	75–76°	74–75°	73–74°	72–73°	71–72°	70–71°	69–70°
Ranunculus Pallasii Schl.	–	–	–	+	+	+	+	+
R. lapponicus L.	–	–	–	+	+	+	+	–
R. hyperboreus Rottb.	–	–	–	+	+	+	+	+
R. pygmæus Wahlenb.	–	–	+	+	+	+	+	+
R. nivalis L.	–	+	+	+	+	+	+	+
R. sulphureus Sol.	–	–	+	+	+	+	+	+
R. acris L. f. *borealis* Trautv.	–	–	–	+	+	+	+	+
R. auricomus L.	–	–	–	+	+	–	+	+
Caltha palustris L.	–	+	+	+	+	+	+	+
Thalictrum alpinum L.	–	–	–	+	+	+	+	+
Fam. Papaveraceæ.								
Papaver nudicaule L.	+	+	+	+	+	+	+	+
Fam. Cruciferæ.								
Matthiola nudicaulis Trautv.	–	–	+	+	+	+	+	+
Cardamine pratensis L.	–	–	+	+	+	+	+	+
C. bellidifolia L.	–	–	+	+	+	+	+	+
Arabis alpina L.	–	–	–	+	+	+	+	+
A. petræa Lam.	–	–	–	+	+	+	+	+
Eutrema Edwardsii R. Br.	–	–	–	+	+	+	+	+
Braya alpina Koch	–	+	–	+	+	+	+	+
Cheiranthus pygmæus Adams	–	–	–	+	–	–	–	–
Cochlearia fenestrata R. Br.	–	+	+	+	+	+	+	+
Schivereckia podolica Andrz.	–	–	–	–	–	+	–	–
Draba alpina L.	+	+	+	+	+	+	+	+
D. repens Bieb.	–	–	–	–	–	–	+	+
D. arctica J. Vahl.	–	–	–	+	–	+	–	–
D. hirta L.	–	–	–	+	+	+	+	+
D. fladnizensis Wulf.	–	–	+	+	+	+	+	+
D. muricella Wahlenb.	–	–	–	–	–	–	+	–

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[1] "Botany of British Polar Expedition," in *Journal of Botany*, 1880.

	N. Lat.							
	76–77°	75–76°	74–75°	73–74°	72–73°	71–72°	70–71°	69–70°
Fam. Violaceæ.								
Viola biflora L.	–	–	–	–	–	–	+	+
Fam. Carophyllaceæ.								
Silene acaulis L.	–	–	+	+	+	+	+	+
Wahlenbergia apetala Fr.	–	–	+	+	+	+	+	+
W. affinis Vahl.	–	–	+	–	–	+	+	+
Stellaria longipes Goldie	–	–	+	+	+	+	+	+
S. humifusa Rottb.	–	–	–	+	+	+	+	+
S. crassifolia Ehrh.	–	–	–	–	–	–	–	+
Cerastium alpinum L.	–	+	+	+	+	+	+	+
C. trigynum Vill.	–	–	–	+	–	–	–	–
Alsine biflora L.	–	–	–	+	–	+	+	+
A. imbricata C. A. M.	–	–	–	+	–	–	–	–
A. rubella Wahlenb.	–	–	–	+	+	+	+	+
Arenaria ciliata L.	–	–	–	–	+	+	+	+
A. peploides L.	–	–	–	–	–	+	+	+
Sagina nivalis Fries.	–	–	–	+	+	+	–	–
S. saxatilis Wimm.	–	–	–	–	–	–	–	+
Fam. Papilionaceæ.								
Hedysarum obscurum L.	–	–	–	+	+	+	+	+
Astragalus alpinus L.	–	–	+	+	+	+	+	+
A. frigidus A. Gray	–	–	–	+	+	+	+	+
Oxytropis campestris D. C.	–	+	+	+	+	+	+	+
Fam. Rosaceæ.								
Rubus Chamæmorus L.	–	–	–	+	+	+	+	+
Comarum palustre L.	–	–	–	–	+	–	+	+
Potentilla pulchella R. Br.	–	–	–	+	–	+	–	+
P. fragiformis Willd.	–	–	+	+	+	+	+	+
P. nivea L.	–	–	–	+	–	–	–	–
P. maculata Pourr.	–	–	–	–	–	+	+	+
Dryas octopetala L.	–	+	+	+	+	+	+	+
Fam. Halorageæ.								
Hippuris vulgaris L.	–	–	–	–	+	–	+	+

	N. Lat.							
	76–77°	75–76°	74–75°	73–74°	72–73°	71–72°	70–71°	69–70°
Fam. SAXIFRAGACEÆ.								
Saxifraga oppositifolia L.	+	+	+	+	+	+	+	+
S. flagellaris Willd.	−	+	+	+	+	+	+	−
S. aizoides L.	−	−	−	+	+	+	+	+
S. Hirculus L.	−	−	+	+	+	+	+	+
S. stellaris L. f. *comosa* Poir.	−	−	+	+	+	+	+	+
S. nivalis L.	−	+	+	+	+	+	+	+
S. hieraciifolia Waldst. & Kit.	−	−	+	+	+	+	+	+
S. cernua L.	−	+	+	+	+	+	+	+
S. rivularis L.	−	−	+	+	+	+	+	+
S. cæspitosa L. f. *decipiens* Ehrh.	−	+	+	+	+	+	+	+
Chrysosplenium alternifolium L.	−	−	−	+	+	+	+	+
Fam. PARNASSIACEÆ.								
Parnassia palustris L.	−	−	−	−	−	−	−	+
Fam. CRASSULACEÆ.								
Sedum Rhodiola D. C.	−	−	−	+	+	+	+	+
Fam. UMBELLIFERÆ.								
Pachypleurum alpinum Ledeb.	−	−	−	−	+	+	+	+
Fam. ONAGRACEÆ.								
Epilobium latifolium L.	−	−	−	+	+	+	−	−
E. alpinum L.	−	−	−	+	−	−	+	+
E. palustre L.	−	−	−	−	−	−	+	+
Fam. VALERIANACEÆ.								
Valeriana capitata Pall.	−	−	−	+	+	+	+	+
Fam. COMPOSITÆ.								
Pyrethrum bipinnatum Willd.	−	−	−	−	−	−	+	+
Matricaria inodora L. v. *phæocephala* Rupr.	−	−	−	+	+	+	+	+
Artemisia borealis Pall.	−	−	−	+	+	+	+	+
A. vulgaris L. v. *Tilesii* Ledeb.	−	−	−	+	+	+	+	+
Arnica alpina Olin.	−	−	−	+	+	+	−	−
Senecio palustris L. f. *congesta* Hook.	−	−	−	−	+	−	−	−
S. campestris D. C. v. *integrifolius* Hook.	−	−	−	−	−	−	+	+
S. frigidus Less.	−	−	−	−	−	−	+	+
S. resedifolius Less.	−	−	−	−	−	+	+	+
Antennaria carpathica, R. Br.	−	−	−	+	+	+	+	+
Erigeron uniflorus L.	−	−	−	+	+	+	+	+
Petasites frigida Fr.	−	−	−	+	+	+	+	+
Taraxacum officinale Web.	−	+	−	+	+	+	+	+
T. phymatocarpum J. Vahl.	−	−	−	+	+	+	+	+

	N. Lat.							
	76–77°	75–76°	74–75°	73–74°	72–73°	71–72°	70–71°	69–70°
Fam. Campanulaceæ.								
Campanula rotundifolia L.	–	–	–	–	+	+	–	–
C. uniflora L.	–	–	–	+	+	+	+	+
Fam. Pyrolaceæ.								
Pyrola grandiflora Raddi.	–	–	–	+	+	+?	+?	+?
Fam. Vacciniaceæ.								
Arctostaphylos alpina L.	–	–	–	–	+	–	+	–
Vaccinium Vitis-idæa L. f. *pumila* Horn.	–	–	–	+	+	–	+	+
V. uliginosum L.	–	–	–	+	+	–	+	+
Fam. Primulaceæ.								
Primula stricta Horn.	–	–	–	–	+	+	–	+
P. farinosa L.	–	–	–	–	–	+	+	+
Androsace septentrionalis L.	–	–	–	–	–	+	–	–
A. Chamæjasme Koch	–	–	–	–	–	–	+	+
A. triflora Adams	–	–	–	–	+	+	–	–
Cortusa Matthioli L.	–	–	–	–	–	–	+	+
Trientalis europæa L.?	–	–	–	–	–	–	–	–
Fam. Plumbaginaceæ.								
Armeria sibirica Turcz.	–	–	–	+	–	–	+	+
Fam. Polemoniaceæ.								
Polemonium cæruleum L. f. *acutifolia* Willd.	–	–	–	+	+	+	+	+
P. pulchellum Bunge	–	–	+	+	+	+	–	+
Fam. Asperifoliæ.								
Myosotis alpestris Koch	–	–	+	+	+	+	+	+
Eritrichium villosum Bunge	–	–	+	+	+	+	+	+
Fam. Gentianaceæ.								
Gentiana chrysoneura Ekstam & Murb.	–	–	–	–	+	–	–	–
G. tenella Fr.	–	–	–	–	+	–	–	–
Fam. Personatæ.								
Pedicularis sudetica Willd.	–	–	–	+	+	+	+	+
P. lanata Willd. f. *dasyantha* Trautv.	–	–	–	+	+	+	+	+
P. hirsuta L.	–	–	+	+	+	+	+	+
P. Oederi Vahl.	–	–	–	+	+	–	+	+
P. lapponica L.	–	–	–	+	–	–	+	+
Fam. Selaginaceæ.								
Lagotis glauca Gärtn. f. *Stelleri* (Cham & Schl.)	–	–	+	–	–	–	–	–

	N. LAT.							
	76–77°	75–76°	74–75°	73–74°	72–73°	71–72°	70–71°	69–70°
Fam. PLANTAGINACEÆ.								
Plantago maritima L. f. *pumila* Kjellm.	–	–	–	–	–	–	–	+
Fam. POLYGONACEÆ.								
Polygonum Bistorta L.	–	–	–	–	–	–	+	+
P. viviparum L.	–	–	+	+	+	+	+	+
Rumex arcticus Trautv.	–	–	–	–	–	–	+	+
R. domesticus Hartm. f. *nana* Hook.	–	–	–	–	+	–	–	–
R. Acetosa L.	–	–	–	+	+	+	–	+
Oxyria digyna Hill	+	+	+	+	+	+	+	+
Koenigia islandica L.	–	–	–	+	+	–	–	–
Fam. EMPETRACEÆ.								
Empetrum nigrum L.	–	–	–	–	–	–	+	–
Fam. BETULACEÆ.								
Betula nana L.	–	–	–	+	+	+	+	+
Fam. SALICINEÆ.								
Salix polaris Wahlenb.	–	–	+	+	+	+	+	+
S. herbacea L.	–	–	–	–	–	–	–	+
S. rotundifolia Trautv.	–	–	–	+	+	+	+	+
S. reticulata L.	–	–	–	+	+	+	+	+
S. arctica Pall. et var. *Brownei* And.	–	–	+	+	+	+	+	+
S. glauca L. et f. *subarctica* Lundstr.	–	–	+	+	+	+	+	+
S. reptans Rupr.	–	–	–	+	+	+	–	+
S. ovalifolia Trautv.	–	–	–	–	–	+	+	–
S. tajmyrensis Trautv.	–	–	–	+	+	+	–	–
S. lanata L.	–	–	–	+	+	+	+	+
S. myrsinites L.	–	–	–	–	–	+	+	+
Fam. LILIACEÆ.								
Allium sibiricum L.	–	–	–	–	–	–	–	+
Lloydia serotina Reichb.	–	–	–	–	–	–	+	+
Veratrum album L.	–	–	–	–	–	–	–	+

	N. Lat.							
	76–77°	75–76°	74–75°	73–74°	72–73°	71–72°	70–71°	69–70°
Fam. JUNCACEÆ.								
Juncus castaneus Sm.	–	–	–	–	–	+	–	+
J. biglumis L.	–	–	+	+	+	+	+	+
Luzula Wahlenbergii Rupr.	–	–	–	+	+	+	+	+
L. confusa Lindeb.	–	–	+	+	+	+	+	+
L. arctica Blytt	–	–	–	+	+	+	+	+
L. spicata D. C.	–	–	–	+	–	–	–	–
Fam. CYPERACEÆ.								
Eriophorum angustifolium Roth.	–	–	–	+	+	+	+	+
E. vaginatum L.	–	–	–	+	+	+	+	+
E. Callithrix Cham.	–	–	–	+	–	–	–	+
E. russeolum Fr.	–	–	–	–	–	–	–	+
E. Scheuchzeri Hoppe	–	–	–	+	+	+	+	+
Carex pulla Good.	–	–	–	+	+	+	+	+
C. rotundata Wahlenb.	–	–	–	–	–	–	–	+
C. fuliginosa Schk. = *C. misandra* R. Br.	–	–	–	+	+	+	+	+
C. rariflora Sm.	–	–	–	–	+	+	+	+
C. salina Wahlenb.	–	–	–	+	–	+	+	+
C. aquatilis Wahlenb.	–	–	–	+	+	+	+	+
C. acuta L.	–	–	–	–	–	+	–	–
C. rigida Good.	–	–	–	+	+	+	+	+
C. hyperborea Drej.	–	–	–	–	–	–	+	–
C. lagopina Wahlenb.	–	–	–	–	–	–	+	+
C. glareosa Wahlenb.	–	–	–	+	–	+	+	+
C. Ursina Desv.	–	–	–	–	+	+	+	+
C. incurva Lightf.	–	–	–	–	–	–	+	+
C. dioica L. f. *parallela* Laest.	–	–	–	–	–	–	+	+
C. rupestris All.	–	–	–	+	+	+	+	–
Fam. GRAMINEÆ.								
Elymus arenarius L.	–	–	–	–	–	–	–	+
Festuca rubra L. f. *arenaria* Osb.	–	–	+	+	+	+	+	+
F. ovina L. et. f. *brevifolia* R. Br.	–	–	+	+	+	+	+	+
Poa pratensis L.	–	–	+	+	+	+	+	+
P. alpina L.	–	–	–	+	+	+	+	+
P. arctica R. Br. et f. *stricta* Lindeb.	–	–	–	+	+	+	+	+
P. abbreviata R. Br.	–	–	–	+	–	–	–	–
Arctophila fulva Nym.	–	–	–	+	+	–	+	+
Glyceria Kjellmanni J. Lge.	–	–	–	+	–	–	–	–
G. Vahliana (Liebm.) Fr.	–	–	–	+	+	–	–	–

	N. Lat.							
	76–77°	75–76°	74–75°	73–74°	72–73°	71–72°	70–71°	69–70°
G. vilfoidea (Ands.) Th. Fr.	–	–	–	–	–	+	+	–
G. tenella J. Lge.	–	–	–	–	–	+	+	+
G. vaginata J. Lge.	–	–	–	–	–	–	–	+
Pleuropogon Sabinii R. Br.	–	–	+	+	+	+	–	+
Phippsia algida R. Br. et *concinna* Fr.	–	–	+	+	+	+	+	+
Colpodium latifolium R. Br.	–	–	–	+	+	+	–	+
C. humile Lge.	–	–	–	–	–	–	+	–
Dupontia Fisheri R. Br.	–	–	–	+	+	+	+	+
Trisetum subspicatum L.	–	–	–	+	+	+	+	+
Aira cæspitosa Beauv.	–	–	+	+	+	+	+	+
A. alpina L.	–	–	–	+	+	–	–	+
Alopecurus alpinus Sm.	–	–	+	+	+	–	+	+
A. pratensis L. f. *alpestris* Wahlenb.	–	–	–	+	–	+	–	+
A. ruthenicus Weinm.	–	–	–	–	+	–	–	–
Phleum pratense L.	–	–	–	–	+	–	–	–
Hierochloe alpina R. & S.	–	–	+	+	+	+	+	+
H. pauciflora R. Br.	–	–	–	–	+	+	+	+
Calamagrostis neglecta Gaertn. = *C. stricta* P.B. = *C. Holmii* Lge.	–	–	–	+	+	–	–	+
C. strigosa Boug.	–	–	–	–	+	–	–	–
Koeleria cristata Gaud.	–	–	–	–	–	–	+	+
Cryptogamæ Vasculares.								
Equisetaceæ.								
Equisetum arvense L.	–	–	–	+	+	+	+	+
E. scirpoides Mich.	–	–	–	+	+	–	–	–
Filices.								
Cystopteris fragilis Bernh.	–	–	–	+	+	+	+	+
Lycopodiaceæ.								
Lycopodium Selago L.	–	–	–	+	+	–	+	+
Summary	4	16	49	134	135	132	145	158

In the above table, 193 phanerogams and four vascular cryptogams are admitted as the known flora of Waigats, Novaya Zemlya, and Lütke and

Barents Lands. In the excellent paper by Herr O. Ekstam[1] on the flora of Novaya Zemlya, he includes in his list 200 plants, but I have deemed it expedient to deduct from that enumeration the following, viz.: *Ranunculus affinis*, for the reasons advanced in the text; *Pyrola minor*, its presence not having been satisfactorily established; *Draba oblongata*, *D. altaica*, *D. lactea*, and *D. corymbosa* as synonyms (O. Gelert,[2] "Notes on Arctic Plants"); *Salix Brownei*, which is here included as a variety of *S. arctica*; *Festuca brevifolia* = *F. ovina*; *Poa stricta* = *P. arctica*; *Catabrosa concinna* = *Phippsia algida*; and *Calamagrostis Holmii*, included under the head of *C. neglecta*. On the other hand, eight names are added to this list:—

Ranunculus auricomus.
Alsine imbricata.
Potentilla nivea.
Gentiana tenella.
Empetrum nigrum.
Veratrum album.
Poa abbreviata.
Koeleria cristata.

Bringing up the number of plants enumerated in the accompanying table to 197.

It is to be observed that the zones of 76–77° and 75–76° are in a botanical sense uninvestigated.

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[1] *Botanische Jahrbücher*, xxii. 185, Leipzig, 1896.

[2] *Særtryk af Botanisk Tidsskrift*, Kjöbenhavn, 1898.

APPENDIX D

NOTE ON LICHENS FROM NOVAYA ZEMLYA.

COLLECTED BY COLONEL H. W. FEILDEN.

THE small collection of lichens made in Novaya Zemlya in 1897 was sent to the Royal Gardens, Kew, on the return of Mr. Pearson's expedition, and by the courtesy of the Director, Sir William T. Thiselton-Dyer, F.R.S., was submitted for identification to Dr. Wainio, of Helsingfors, who determined them.

It may be as well to say that lichens were not systematically collected, and only small gatherings were made at two localities—namely, from the summit of a hill at the eastern entrance to Beluga Bay, Matyushin Shar, at an elevation of about 850 feet, and approximately in 73° 15′ N. lat. The other station was the summit of a hill about 1400 feet in altitude, on the south side of Ziwolka Fjord, on the east coast of Lütke Land, in about 74° 25′ N. lat.

Observations in regard to lichen growth in Novaya Zemlya tend to confirm my previous experiences in other Arctic regions, that as we ascend from the shore-line, and attain the higher elevations from which the snow is periodically removed in summer, we usually find lichens increasing both in quantity and species. This I particularly noticed on the top of the hill at the entrance to Beluga Bay, where, after an ascent of 800 feet, and the almost complete disappearance of phanerogamic vegetation, we found each rock and stone clad with a luxuriant lichen growth, whilst at the shore-line only a few minute species were to be found incrusting the beach pebbles.

It is suggestive that in this small collection of Novaya Zemlya lichens, gathered at haphazard, Dr. Wainio should have discovered two new species and some varieties. We may, therefore, be assured that Novaya Zemlya will yield a rich harvest of novelties when explored by a competent lichenologist.—H. W. F.

Lecidea chionophiloides, Wain. (forma nova).
L. lulensis (Hellb.), f. *epichlora*, Wain.
L. chionophila (Th. Fr.), Wain.
L. Dicksoni, Ach.
L. geographica (L.), Schaer.
L. arctogena, Th. Fr. (forma nova).
L. aglœa, Sommerf.
Lecidea, Wain., n. sp.

L. mollis (Wahlenb.), Nyl.
L. inarensis, Wain.
Umbilicaria erosa (Web.), Hoffm.
U. proboscidea (L.), D.C.
Umbilicaria, Wain., n. sp.
U. cylindrica (L.), Delise, var. *laciniata* (Retz.), Wain.
Buellia atrata (Sm.), Hepp.
Parmelia alpicola, Th. Fr.
P. centrifuga (L.), Ach.
P. pubescens (L.), Wain.
P. omphalodes (L.), Ach.
Solorina crocea (L.), Ach.
Hæmatomma ventosum (L.), Koerb.
Lecanora polytropa (Ehrh.), f. *stenotropa*, Nyl.
Acarospora cinerea (Schaer.), Wain.
Alectoria ochroleuca (Ehrh.), Nyl.
Stereocaulon alpinum, Laur.
Gyrophora proboscidea (L.), Ach.

APPENDIX E

FUNGI FROM NOVAYA ZEMLYA, WAIGATS, DOLGOI ISLAND, AND HABAROVA.

THE following Fungi were found on phanerogams collected by Colonel H. W. Feilden in 1897, and identified at the Royal Gardens, Kew.

PYRENOMYCETES.

Pleospora Herbarum, Rab., on *Arenaria ciliata*, Beluga Bay of Goose Land; on *Matthiola nudicaulis*, Waigats, south shore; on *Braya alpina*, Silver Bay.

P. Herbarum, Rab., *forma* Polemonii, Oudem., on *Polemonium cæruleum*, Habarova.

P. Arctagrostidis, Oudem., on *Phippsia algida*, Seal Harbour, Matyushin Shar.

P. Cerastii, Oudem., on *Cerastium alpinum*, Ziwolka Fjord.

Pyrenophora chrysospora, Sacc., on *Pedicularis hirsuta*, Dolga Bay, Waigats.

P. helvetica, Sacc., on *Androsace triflora*, Nameless Bay.

Leptosphæria Hierochloæ, Oudem., on *Hierochloe alpina*, Dolga Bay, Waigats.

Sphærella innumerella, Karst., on *Comarum palustre*, south shore, Waigats.

Ascochyta, n. sp., on *Myosotis alpestris*, Waigats.

USTILAGINEÆ.

Ustilago violacea, Winter, on *Wahlenbergia affinis*, Pachtussow Island.

Doassansia Epilobii, Farlow, on *Epilobium palustre*, Habarova. (New to Europe; a North-American species.)

SPHÆROPSIDEÆ.

Septoria Eriophori, Oudem., on *Eriophorum angustifolium*, Beluga Bay, Matyushin Shar; on *Eriophorum Scheuchzeri*, Dolgoi Island.

Phoma Junci, Preuss., on *Luzula confusa*, hill east side entrance to Beluga Bay, Matyushin Shar, 850 feet, Dolga Bay, Waigats.

Phoma Graminis, West., on *Poa alpina*, Habarova; on *Poa cenisea*, Pachtussow Island; on *Poa cenisea*, Gubina Bay and Nameless Bay.

APPENDIX F

NOTES ON THE GLACIAL GEOLOGY OF ARCTIC EUROPE AND ITS ISLANDS.[1]

PART I.—KOLGUEV ISLAND.

By Colonel H. W. Feilden, F.G.S., with an Appendix by
Prof. T. G. Bonney, D.Sc., F.R.S.

During the month of July 1895, after two ineffectual attempts to reach Novaya Zemlya, owing to the great accumulation of ice in Barents Sea, we ran down the edge of the ice-pack, which extended intact from Novaya Zemlya to the northern end of the island of Kolguev. We were fortunate enough to meet with a day so fine and a sea so smooth that our party of five persons landed without difficulty at the mouth of the Gobista River, on the south-western side of Kolguev. Our yacht was sent back to Vardö for coal, and we remained on Kolguev for ten days, encountering very inclement weather. A most opportune break in an almost continuous series of gales and fogs enabled us to leave Kolguev on the return of our vessel, without difficulty or danger.

The island of Kolguev lies in Barents Sea, distant some 50 miles from the mainland of Arctic Russia, and about 130 miles south-west from the nearest part of Novaya Zemlya. Its greatest breadth is about 50 miles, and its extreme length 40 miles; the general shape is oval. The superficial area may be roughly estimated at 2000 square miles. As a familiar comparison, we might liken it in extent to our East Anglian county of Norfolk.

The soundings between Kolguev and the mainland of Europe do not exceed 30 fathoms, while, in all probability, 70 fathoms is the extreme depth between it and Novaya Zemlya. Kolguev, however, differs entirely in geological structure from the mountainous islands of Novaya Zemlya, and equally so from the ice-worn rock area of Russian Lapland, as throughout its entire extent no exposure of basement-rock has been anywhere observed. It is wholly and entirely a vast accumulation of glacio-marine beds.

The appearance of the western side of Kolguev, though we coasted along it in favourable weather and bright sunshine, is dismal and uninteresting. Low bluffs of clay, of a bluish-grey colour and some 60 to 70 feet high, stretch from the mouth of the Gosena River, at the north-western end of the island, to the mouth of the Gobista; but there is a gentle though perceptible lowering of the coast-line from north to south. At the mouth of the Gobista River the height of the shore-bluffs has dwindled to about 40 feet. From the Gobista to the Kriva, some 6 miles south, the land sinks more rapidly, and at the extreme south-western corner of the island merges with the sea, a considerable portion of the island near the sea-shore being overlain with recent sea-sand.

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[1] Extracted from *Quart. Journ. Geol. Soc.*, vol. lii. pp. 52–63.

The margin of the bluffs that form the western shore of Kolguev is not usually a vertical wall of clay, but is generally hidden under a slope or talus which has fallen from above. The destruction of the coast-line would be still more rapid but for the protection given by the snow-foot which forms upon the sloping talus. This snow-foot is merely an immense accumulation which gathers in the ravines or collects upon the slopes. By the combined action of the sun's rays and the wash of the sea, this snow becomes of an ice-like character, and gives effective aid in protecting the cliffs. Though there are no rivers navigable by the smallest sea-going craft, yet there are three streams of considerable size that discharge on the western side of Kolguev. These are the Gosena, Gobista, and Kriva rivers. I have visited only the last two. In addition there are many smaller rivulets that help to drain this supersaturated island, and as they have cut out for themselves deep ravines, far out of proportion to the volume of water that is carried off by them, they give to the clay cliffs a varied character, and in passing along the coast we see ravine, and dell, and steep-sided watercourse, which to a certain extent relieve the monotony. These minor ravines, as a rule, are not of any great length. Originating as runnels in the peat of the flat tundra, they act as drains for carrying off the melted snow and rain-water, but when they approach the shore-bluffs their erosive powers are greatly increased. Not only is there a wearing-out action, but there is an actual eating-back force, so that in the last few hundred yards of their course the stream drops, say, 50 to 60 feet, and cuts out a broad ravine with very steep banks on either side. It was in ravines of this nature that I obtained the chief facilities for examining sections. We find that all these streams in the last part of their course, and when almost on a level with the beach, run over stones and boulders which have been washed out of the surrounding mud-beds. An examination of these stones, which are of every shape and form, from angular fragments to rounded and polished blocks, shows that a large proportion are ice-scratched. The medley of rocks represented is remarkable, granites and gneisses, limestones Silurian and Carboniferous, grits, quartzites, porphyries, a variety indeed so great that it would take a trained petrologist to enumerate them. Even the ordinary observer cannot fail to perceive that an immense land-surface has been put under contribution to supply such a diversity of rocks. These boulders vary in size from that of a walnut to large dimensions. One that lay in a stream-bed a few miles north of the Gobista River was a huge block of very hard yellow sandstone, polished, scored, and striated. Along its major axis it had deep flutings cut into it, and in addition it was transversely scratched. It measured 15 feet in length, 9 feet in breadth, and 6 feet in height. When we look around to the mud-and-clay cliffs, we see here and there stones and boulders of the same character as those that strew the stream-bed sticking out of the banks, or resting on the talus ready to slide down and join the others below; we also observe that these erratics do not exhibit the slightest tendency to form lines of horizontal deposit in the beds. My opinion is that all have been dropped from floating ice intermittently and tranquilly. The matrix of clay around them shows no signs of disturbance; on falling from the ice-rafts they have sunk gently into the yielding mass, and now they lie throughout the beds looking like currants in a cut loaf.

I have no altogether satisfactory explanation to advance for the presence of such immense numbers of ice-scratched stones as occur in these sedimentary beds of Kolguev. The action of an ice-sheet cannot be invoked at Kolguev; yet, seeing that the ice-scratched stones throughout the Kolguev Beds must in the aggregate amount to millions, one naturally asks, where were they manufactured? Undoubtedly stones frozen into the bottom of floating ice become scratched and polished when stranded on shores where there is sufficient rise and fall to admit of the ice-rafts grating. I have seen this process of manufacture going on.[1] It is, however, difficult to conceive a train of circumstances which admitted of erratics being transported in floe-ice to some rocky coast, there to be scratched and then carried out to sea, and deposited on the floor of the ocean. It seems more reasonable to suppose that this great aggregation of ice-scratched erratics came from glaciers, but the difficulty we have to face is, how do ice-scratched stones get from the glacier to the ice-raft? If we admit that the Kolguev erratics came from glaciers, where do we suppose those glaciers to have existed during the period when the Kolguev Beds were deposited?

The Kolguev Beds in the vicinity of the Gobista River may be divided into clays and sands, but their differences of composition merge into one another. Not infrequently the clays pass into horizons of a more sandy composition, although so insensibly that it is difficult to determine exactly where the change takes place. The cliffs are so homogeneous in character, and the passage of the clay stratum into sand is so gradual, that the alteration is evidenced more by the change of colour in the sections than by any definite lines of demarcation. It is evident that no break has occurred in the continuous deposition of these sedimentary beds. I noticed no layers of gravel traversing the beds, and in this respect those of Kolguev differ from the glacio-marine beds of Grinnell Land and Smith's Sound. There the horizons of clay, sand, and gravel are often distinctly defined. This doubtless arises from their deposition close to land in shallow water. The Kolguev Beds were evidently deposited in the sea, farther from shore than the Grinnell Land Beds, and every piece of rock included in them is, I am convinced, an ice-transported erratic.

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[1] *Quart. Journ. Geol. Soc.*, vol. xxxiv. (1878), p. 566.

The fossils found in the Kolguev Beds (I am not referring to those which have been transported as erratics, but to the fossils contemporaneous with the beds themselves) are all mollusca, and well-known boreal forms, existing at the present time. Though in various sections fragments of *Saxicava arctica*, *Mya*, &c., appeared to be dispersed from top to bottom, yet they were certainly rare, and I obtained but few entire examples. I submit, however, that these molluscan remains, found in various localities and through the whole exposed thickness of some of the beds, all of which are (in my opinion) sedimentary, afford proof of their marine origin.

Mr. Edgar Smith has been good enough to carefully examine and name the specimens which I collected, with the following result:—*Natica affinis* (Gmelin) or *N. groenlandica*, Beck; fragments of gasteropod (*Sipho* ? sp.); *Saxicava arctica* (Linn.); *Astarte compressa* (Montagu); *Astarte borealis* (Chemn.); *Mya arenaria* (Linn.); fragments of *Mya*, sp.

I am unable to advance any satisfactory theory, either for the paucity of the molluscan remains in the Kolguev Beds, or for the greater part of what I found being fragmentary. I was unsuccessful in finding the remains of any marine vertebrate, and equally so in discovering driftwood in the beds; the latter, it will be remembered, is abundant in the glacio-marine deposits of Grinnell Land.

It may be interesting to compare, and contrast if need be, the Kolguev boulder clays with the deposits which bear the same name in England and Scotland. I met with no deposit in Kolguev precisely similar to what is called "till" in Scotland. I mean by "till" a firm, tough, tenacious, strong clay; in the words of Prof. James Geikie, "so tough indeed does it often become that engineers would much rather excavate the most obdurate rocks. . . . But till has neither crack nor joint—it will not blast, and to pick it to pieces is a very slow and laborious process."[1] On the other hand, there are many deposits in Britain called "Boulder Clays" which are in no degree superior in toughness to those of Kolguev, for instance, those of the Yorkshire coast; the Chalky Boulder Clays of Norfolk may be also cited as another example. I am inclined to think that the tenacity or the reverse of boulder clays depends greatly on the nature of the rocks from which they have been derived. By these remarks I do not wish to imply the impossibility of till or boulder clay being formed as a *moraine profonde* under an ice-sheet; I merely suggest that many boulder clays in this country and in other parts of the world may have been deposited under water, and that the transport of their included ice-scratched stones may be due to floating ice. It is suggestive that all the boulder clay deposits which I have met with in Arctic and Polar lands, in areas so widely separated as Smith's Sound, Grinnell Land, Northern Greenland, Spitsbergen, and Novaya Zemlya, should be glacio-marine beds. Throughout this wide expanse of the Arctic regions I have come across no clay beds that could be satisfactorily assigned by me to the direct action of land-ice; that is to say, beds formed *in situ* by the grinding force and pressure of an ice-sheet. On the contrary, as far as I can judge, the boulder clay beds which I have traced over the extensive area mentioned have all been deposited subaqueously and re-elevated.

Nowhere have these facts been more strikingly confirmed than by the investigation of the geological structure of Kolguev. There we find a large island emerging from Barents Sea, showing to my mind evidence, by its sedimentary glacio-marine beds, of the absence of an ice-sheet from the area when these beds were deposited, and its formation under conditions similar to those which at present exist in Barents Sea.

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[1] James Geikie, "Great Ice Age," p. 10, London, 1874.

REPORT ON THE ERRATIC BOULDERS FROM THE KOLGUEV BEDS.

By Prof. T. G. BONNEY, D.Sc., LL.D., F.R.S.

(1)[1] A granitoid rock, with reddish felspar, which, under the microscope, is found to consist of grains, rather fragmental in aspect, of quartz and felspar, and of clustered flakes of biotite. These are cemented by a mosaic, partly of smaller quartz-grains, occurring in patches, which at times also suggest that they may possibly be fragmental, partly of quartz and felspar. These smaller quartz-grains contain a large number of hair-like microliths. The felspar, where distinguishable, is either orthoclase, plagioclase, or (rarely) microline. The larger grains contain enclosures of quartz or felspar, or a flake or two of biotite. One or two of the smaller crystals are fairly idiomorphic, but as a rule their outline is rather irregular, and they are sometimes bordered by a micropegmatitic zone, of irregular form, which seems to invade the mineral as though it had been the result of a corrosive process acting from without. The biotite occurs in rather small, irregularly-shaped flakes, of which the larger sometimes contain granules of quartz or felspar. These flakes are clustered in a way that suggests the possibility of their representing an original flake of larger size, which has been broken up and subsequently in part reconstructed. There is a little apatite and zircon. I think that the rock has been subjected to a certain amount of mechanical disturbance, which has been followed by reconsolidation. So far as I can form any opinion as to its age, I should judge it to be Archæan.

(11) A gneissic rock, not strongly banded, consisting chiefly of quartz, a pale reddish felspar, and a dark hornblende. It is very like an Archæan gneiss, such as some of those occurring in Canada, Greenland, &c.

(13) A rock with a darkish microcrystalline ground-mass in which are roundish felspar crystals, up to about one-third of an inch in diameter. Under the microscope it is found to consist of an almost microcrystalline ground-mass, in which are scattered larger crystalline grains. This ground-mass is composed mainly of quartz and felspar, exhibiting occasionally an approach to a pegmatitic structure, but generally forming a rather irregular mosaic, as if the two minerals had simultaneously crystallised. Interspersed with these, with a rather "clustered" habit, are numerous needles, apparently of a darkish

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[1] The numbers within parentheses are those placed by Colonel Feilden on the specimens.

actinolite, and occasional flakelets of biotite. The larger (porphyritic) crystals are both quartz and felspar; the former mineral is not abundant, but it occasionally includes a small grain of felspar or flake of biotite, is sometimes corroded by the ground-mass, and is often cracked. The latter mineral, however, exhibits a structure which is not a common one. It contains numerous enclosed grains, often rather rectangular in outline, of another felspar, and sometimes of quartz, like a "lustre-mottling." These enclosures occur somewhat sporadically, *i.e.* they occupy only a part of a crystal. This also, in one or two cases, has evidently increased in size during the last stage of consolidation. We have found, for instance, two planes (perhaps a basal and a clinodome) outlined by minute flakes of biotite, and marking a change in structure, though not in optical continuity. The outer zone, about $\frac{1}{50}$ inch in maximum breadth, contains a larger number of quartz-enclosures, and these are ranged as if they had grown from the original surface of the crystal, somewhat as the crystals in a granite occasionally group themselves at a junction with another rock. This particular crystal also shows an approach to a micropegmatitic structure, which, however, sometimes passes beyond the boundary. These larger felspars, as a rule, do not exhibit the oscillatory twinning of plagioclase; one or two are orthoclase, twinned on the Carlsbad type, a few probably are microcline. One or two small zircons are present. The rock would be called by some a quartz-felsite or quartz-porphyry, by others a microgranulite. The general structure (except for the peculiarities of the felspar) resembles that of the rock figured by Fouqué and Lévy ("Minéralogie Micrographique," pl. x. fig. 1).

(21) A darkish, purple-spotted grit, which, under the microscope, proves to be composed of fragments, subangular to fairly rounded, of minerals and rocks. Among the former are quartz and felspar, which in one or two cases are associated as if they came from a holocrystalline rock. Among the latter are many fragments of volcanic rocks. These are now devitrified and often rather decomposed, but they evidently were once in a glassy or slaggy condition. Occasionally they are blackened with opacite; felspar-microliths are present in some. Apparently they represent some of the less acid trachytes —probably andesites; possibly, in one or two cases, even basalts. These exhibit considerable variety, so that they hardly can have come from a single volcano, but nothing worthy of detailed description. A fragment or two of a volcanic grit is also found, and the ground-mass contains a little of a carbonate. The rock resembles some of the volcanic grits, which in Britain occur just below (or, as others would say, at) the base of the Cambrian system.

(2) A rock, apparently similar to the last, but containing two or three pebbles up to three-quarter inch in diameter. Two are probably a reddish quartz, a third is green in colour, with colour-zoning, possibly a fine-grained quartzite.

(19) A fine-grained blackish grit, with several little flakes of mica. Under the microscope it is found to be composed of angular fragments of quartz, felspar, and a mudstone or phyllite, with some flakes of white mica, and, more rarely, of biotite. The felspar is often rather decomposed, and full of tiny flakelets of colourless mica, but plagioclase can be recognised. There is a good deal of a brown staining, some of which may be a hydrocarbon; possibly also a trace of a cleavage making a high angle with the bedding. I cannot say more than that I should conjecture the rock from its general appearance to be Palæozoic.

A rough vein-specimen, quartz and calcite, apparently from a "dark slaty rock."

(16) A very pale cream-coloured subcrystalline limestone. Under the microscope it is seen to be slightly dolomitic, and composed of irregularly shaped grains, differing considerable in size. Evidently it once contained rather numerous organisms, but these are too much altered for exact identification. I recognise, however, traces of fragments of lamellibranchs, perhaps one or two small gasteropods, and several foraminifera, not improbably representing *Globigerina*, *Orbulina*, and a Rotaline form. I think the rock very likely to be Mesozoic in age. It resembles some of the purer limestones in the Alps, where they have had a sharp "nip" between the crystallines, and I believe that it has been affected by earth-movements, followed by reconsolidation.

(6) A piece of purplish-red chert. Under the microscope clear spots or veins appear in a brown-speckled ground. On applying the nicols, the clear constituent throughout the slide is found to be chalcedonic quartz, which here and there in the untinted part (where the granules run larger) shows an approach to a spherulitic structure. The tinting material may be called ferrite, but while some of the larger grains can be recognised as brown iron-oxide, others are pyrite. In this part of the slide small cylindrical bodies can be frequently identified, which, though badly preserved, I believe to be sponge-spicules, and there are possibly indications of other organisms. The rock undoubtedly is a chert, but I cannot determine its age.

(17) [1] * Half of a rather large dome-shaped *Favosites gothlandica* (syn. *F.*

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[1] As I was anxious that the identification of the fossils should rest on better authority than mine, I submitted the specimens marked with an asterisk to E. T. Newton, Esq., F.R.S., who has kindly named and commented on them.—T. G. B.

Goldfussi). As this species ranges from the Silurian into the Devonian, the age is uncertain.

(3) * A darkish fossiliferous limestone. "The greater part of this is made up of *Amphipora* (*Caunopora*) *ramosa*, a Stromatoporid peculiarly Devonian;" with it a coral, which may be a *Dibunophyllum*, and probably a piece of *Monticulipora*.

(14) * Piece of grey limestone containing *Diphyphyllum*.

* Eight smallish specimens, very full of fragmental organic remains, seemingly to some extent etched out by action of water. One specimen, measuring about 2 inches by 1¼ inch, contains the spiral arm of a brachiopod (? *Spirifera*), a crinoid stem, and piece of a lamellibranch. In one of the others we find *Polypora*, with fragments, large and small, of Monticuliporids. Similar organisms occur in the rest, one possibly containing *Fenestella*, if it be not *Polypora*. May be Carboniferous in age, possibly older.

(22) * A fragment, about 1½ inch long and not quite three-quarter inch wide at the narrower end, of a belemnite, with an excentric alveolus, extending to within a quarter inch of the bottom. [This has since been determined by Mr. G. C. Crick as almost certainly *Belemnites subquadratus*, a species recorded from the Upper Portlandian of the coast opposite Kolguev Island.]

The specimens of an olive-grey fine-grained sandy mudstone, with plant remains, and of lignite, were submitted to A. C. Seward, Esq., M.A., F.G.S., who has kindly furnished the following notes:—

"(12) In this specimen, a microscopical examination of the surface reveals the existence of a structure which is probably that of imperfectly silicified coniferous wood. The cavities of the tracheæ appear to have been filled with silica, and present the appearance of delicate and regularly-arranged rods; here and there the series of longitudinally-running rods are crossed by others at right angles, suggesting medullary rays seen in radial view. I am unable to make out any character which will enable me to pronounce a definite opinion as to the geological age of the rock.

"(4) Preservation similar to that in specimen No. 12. Impressions of coniferous wood. The irregularly pitted portions are also, I believe, weathered pieces of wood; a very similar appearance is presented by undoubted specimens of coniferous wood in my possession.

"(5) Fragments of coniferous wood.

"(17) Fragments of carbonised coniferous wood. Sections of a small piece of this wood show fairly well the tracheids and medullary-ray cells characteristic of the Coniferæ, but the preservation is not sufficiently good to enable one to offer an opinion as to the precise nature of the plant.

"*Lignite* (A).—A piece of coniferous wood with distinct annual rings. There appear to be large resin-ducts traversing the spring wood longitudinally. Possibly a more complete examination of thin sections may lead to a generic or even a specific determination.

"*Lignite* (B).—A naked-eye examination of this smaller piece of lignite brings out the features of coniferous wood. The annual rings are fairly well marked. In thin slices the tracheids and medullary rays are clearly seen, but the preservation is not sufficiently good for one to recognise the manner of occurrence of the bordered pits. In one slide there are a number of fungal hyphæ distinctly preserved, running irregularly through the woody tissues.

"The general impression arrived at from an examination of the specimens is that the rocks are probably Mesozoic in age, and either Jurassic or Wealden. But, without further evidence, it would be rash to offer a more definite opinion as to the geological horizon."

ICE-WORN STONES.

These are all striated, and in form resemble the ice-worn specimens from a till or boulder-clay. Though I have not used an acid, and scarcely employed the knife, I think the following determinations are correct.

(2) A fine-grained dark grit, probably identical with (19).

(9) A slate-grey limestone, apparently a piece of Carboniferous Limestone.

(18) A dark grey limestone, Carboniferous, or possibly Devonian, not unlike the matrix of (3).

(15) An almost black compact limestone (? traces of small organisms); very like some of the darker Carboniferous Limestone of Britain.

(10) A heavy compact brown rock, probably a piece of ironstone (? Carboniferous).

In addition to the above-mentioned specimens are five glass tubes, containing samples of the glacial deposits, described by Colonel Feilden; in four cases clay, in the other sand. Small portions of each have been studied under the microscope. In those from the clay I have identified the following minerals:—Fairly common: quartz and felspar (plagioclase and microcline recognised); much more sparingly, a colourless mica, hornblende and augite—both green-coloured, garnet, zircon, iron oxides, and rounded grains of glauconite, some certainly the casts of foraminifera.

The tube marked A was filled with lumps of a rather hard, dark, brownish-grey clay, and in the preparations from it I also found a sponge-spicule. B contained a mixture of a more earthy deposit, nearly the same colour as the clay, with a little grey sand. Here I identified the speckled filmy substance frequently seen in muds and the colourless mica was more abundant. There was also a little biotite and one or two sponge-spicules. C contained a material like A, but a little darker in colour and not quite so coherent. Here too was the filmy substance as before, also chlorite or a greenish biotite, a sponge-spicule, and one possibly belonging to some other organism. D contained a rather light grey silty clay; fragments of garnet were rather commoner in this, and one or two rounded prisms of a slightly ferruginous rutile. E contained a fine-grained quartzose sand. This proved to be wholly composed of mineral fragments, mainly quartz; possibly a few chips were from flint. Garnet, colourless mica, glauconite, iron oxide, and sponge-spicules were fairly common. In all these samples the fragments are mostly angular or subangular, a rounded grain, which sometimes is rather larger in size than the rest, only occasionally being found. The materials bear a general resemblance to those forming the Glacial drift of East Anglia.

APPENDIX F

NOTES ON THE GLACIAL GEOLOGY OF ARCTIC EUROPE AND ITS ISLANDS.[1]

PART II.—ARCTIC NORWAY, RUSSIAN LAPLAND, NOVAYA ZEMLYA, AND SPITSBERGEN.

By Colonel H. W. FEILDEN, F.G.S., with an APPENDIX by Prof. T. G. BONNEY, D.Sc., F.R.S., V.P.G.S.

1. PROOF OF CHANGES OF LEVEL IN NORTHERN NORWAY.

So much has been written about the glacial geology of Northern Norway by great authorities, that I should have refrained from discussing the subject had I not recently heard a paper[2] read at a meeting of this Society, in which the author suggested that the terraces in the transverse fjords of North-Western Norway would be perfectly explained by the formation of ice-dammed lakes. The author, however, admitted that the authenticated occurrence of marine organisms in these raised beaches would be a conclusive argument against his views. I have never made any special study of the phenomena connected with the secular upheaval of Arctic Norway, for I had always been under the impression that few geological facts were more generally accepted as well established than the recent elevation of land in Arctic latitudes, including Northern Norway. My observations are consequently somewhat cursory, but I do not remember landing on any of the more considerable islands north of the Arctic Circle that form the "Skjergaard" of Norway, without noticing traces of recent elevation and deposits containing abundantly shells of mollusca of the same species as those that now inhabit the adjacent sea. The same holds good of the "Westeraalen," and I observed last summer a well-defined raised beach near the settlement of Rissohavn, on the island of Andö, full of the shells of recent mollusca; this beach was overlain by four feet of peaty soil, in which grew birch-trees.

The lofty chain of the Lofoten Islands has not been buried under an ice-cap. Their sharply-peaked and serrated mountain-tops, rising from the sea to altitudes between 2000 and 3000 feet, present no evidence of ever having been overwhelmed by the Scandinavian ice-sheet. There are, however, unmistakable signs that at one period of their history great glaciers filled their valleys. The celebrated Trold Fjord near the western entrance of Raft Sund, the channel between Eastern Vaagö and Hindö, is a narrow but majestic fjord with perpendicular walls of rock on both sides; these, to the height of some 400 feet, are polished and grooved by the action of ice, but the mountain peaks that rise above the fjord show no signs of glacial abrasion Attention has been called to this by earlier writers, notably by the late J. F. Campbell[1] and by Prof. Bonney.[2] Passing up Raft Sund, amid some of the finest coast scenery of Norway, one cannot fail to observe the traces on all sides of former glacial action, especially on the eastern shores of the channel. There nearly every valley descending to the shore-line, now bright with green birch-woods and pastures, has the remains of great moraines at its mouth. Farther north, around Tromsö, the signs of recent elevation are common along the shore-line, and so also the signs of the retreat and disappearance of glaciers which once filled the valleys; but I see no evidence that the mountain-tops on the mainland of this part of Norway have ever been covered by an ice-sheet, even at the time of their maximum glaciation.

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[1] Extracted from *Quart. Journ. Geol. Soc.*, vol. lii. pp. 721–746.

[2] Boulger, *Quart. Journ. Geol. Soc.*, vol. li. (1895), p. 494.

The valley of Tromsödal, on the mainland opposite the town of Tromsö, has a conspicuous raised terrace passing across its mouth, and continued north and south along the present coast-line. This terrace must be a quarter mile wide at the mouth of the valley; and there brick-works are established. In 1894 a good section of this terrace, some twenty feet in height, was exposed, from which the clay used in the works was being taken. From base to summit it is a homogeneous mass of blue clay, with boulders and stones interspersed throughout. There is not a trace of bedding throughout the mass. As I considered this deposit to be a typical example of boulder-clay formed under water, I took advantage of my journey in the neighbourhood last summer to revisit the spot. A more careful examination showed that the clay contains ice-scratched stones, and that mollusca are abundant throughout the bed; examples of *Cyprina islandica* and *Pecten islandicus*, partially retaining their colour, are common, likewise stones to which the "bases" of a *Balanus* are attached. On ascending the terrace, which at its base is only a few feet above present high-tide mark, and looking up the valley, one can realise that, apart from its composition, it owes its formation to glacial causes. This terrace is flat on the top, and at the outer edge slopes seaward, and the same on its opposite side looking up the valley. There can be no doubt that this valley was formerly occupied by a glacier; and when the land stood at a lower level than it does to-day, the front of the glacier was in the sea, and the terrace was formed by the material which passed from under the ice, and is therefore a kind of subaqueous moraine.

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[1] "Frost and Fire," vol. i. (1865), Nos. 136–137.

[2] *Alpine Journal*, vol. iv. pp. 430–436; "Do Glaciers Excavate?" *Geographical Journal*, vol. i. (1893), pp. 481–499; "Ice-Work, Present and Past," p. 175, London, 1896.

As we sail from Tromsö towards the North Cape, the course takes us through Kaag Sund and past the island of Arnö. The southern shore of that island is fringed for miles by three great parallel terraces. I roughly estimate Arnö at about 1200 feet in altitude, and the terraces at 50, 100, and 150 feet above sea-level. Their position on an island exposed to the full force of a stormy ocean is entirely opposed to the possibility of ice-dams having had any connection with their construction. In Magerö Sund, which separates from the mainland the island whence juts out the North Cape, sea-worn caves, much above the present sea-level, tell of recent elevation of the land.

The remarkable terraces in the Porsanger and other northern fjords of Norway have been noticed by Bravais, Martens, J. D. Forbes, Chambers, Campbell, Bonney, and others in their descriptions of this part of Norway. The Porsanger is the first of the large fjords that run into the mainland of Finmark. The hills on either side are low, probably not more than 500 feet in altitude. They have an ice-planed, ice-smoothed contour. The topographical contrast between this area and the peaked Lofotens and those around and immediately south of Tromsö is striking. The island of Stor Tamsö lies in the centre of the Porsanger Fjord. Its greatest height is probably not more than 300 feet; it is about seven square miles in extent. Evidently an ice-worn surface, it is entirely, or almost entirely, covered with a growth of peat, showing a depth in places of 8 or 9 feet before reaching the polished underlying rock, which is a rather felspathic quartz-schist.[1] Where I landed, the rock, smooth and slippery, passes with a gentle slope into the sea. Our boat ran up this rock as over a sand-beach, while both below and above the tide-mark the rock is so grooved with glacial striæ that it looks as if they had been made by the keels of boats hauled over sand which had subsequently indurated, while in reality it is a very hard quartz-schist. This island is girdled in part by a series of old beaches rising one above the other to a height of not less than 100 feet. The highest that I traced looks like a line of ancient fortification. This is due to the accumulation of peat which has spread over it, and which, sloping towards the sea, is on the land-side in many places perpendicular. Where runnels have cut through this terrace the ancient beach is exposed; in it are fragments of nullipores identical with the remains that are piled up along the shore at present sea-level, and these at a little distance look like accumulations of magnified grains of sago. The presence of the remains of this nullipore in the higher terraces effectually disposes of the theory that these beaches might have been the result of interglacial damming.

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[1] See Professor Bonney's determination of this rock, p. 253.

The remarkable and extensive series of terraces on both sides of the Varanger Fjord, which separates Norway from Russian territory, are well known. My friend Professor Alfred Newton, who visited the Varanger forty years ago, kindly gave me the following note from his journal and that of Mr. W. H. Hudleston, his companion. They were journeying along the northern side of the fjord, not far from Vadsö. He writes:[1]—"We continued our walk along a raised beach about 50 feet above high-water and 200 yards from the shore, where lay the bones of a whale that had probably been stranded there in old times. Each of the whale's vertebræ was covered with turf. We scratched the ground in places and found ribs, but I do not remember that we found the head."

On the little island of Vardö, on which the town is built, and near the fort from which the island takes its name, is a marine sand-deposit some 40 to 50 feet above sea-level. I lately took from this spot remains of seal,[2] cetaceans, fishes, and mollusca. I might easily enlarge the list of localities in Arctic Norway which I have visited, and where similar proofs of recent elevation are to be met with; but I think that I have conclusively shown the presence of marine organisms throughout the raised beaches of Arctic Norway, and consequently their marine origin.

2. Terrace-Making in Kolguev Island.

On former occasions[3] I have pointed out the part which the ice-foot performs in the formation of terraces in Polar regions. I observed the making of a terrace lately on the island of Kolguev, not on a great scale, but still sufficiently important to be a guide. The broken ice-pack was pressed on to the western shore of Kolguev by a strong gale for three days. The width of this pack as I saw it was from a half to three-quarters of a mile; it was a chaos of ice-material, blocks and fragments pressed together by the force of the gale which was raging outside, and huge waves dashing over the windward side of the pack. Standing on the beach, the crushing and grinding of the ice-blocks, with their dismal groaning, was audible above the noise of the wind. An "angry" pack under such circumstances is a very awe-inspiring force of Nature. As the ice pressed on the shore, it drove before it banks of mud and gravel; these were pushed up in ridges several feet high, and the tops of these banks were rough and irregular. The gale died away, and the ice, which had acted as a breakwater, disappeared. Then came the influence of the sea. No longer kept back from exerting its power on the shore-line by the protective ice-barrier, the waves at the height of the tide pushed their crests over the heaped-up ridges of mud and gravel, and as they surged along levelled them as flat as a billiard-table. As successive tides came in, not so high or strong as those immediately following the gale, the raised surface was cut parallel to the shore-line as straight and perpendicular as if done by a spade for considerable lengths, according to the nature of the shore.

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[1] Alfred Newton, *in litt.* 1895.

[2] Mr. E. T. Newton, F.R.S., F.G.S., very kindly identified these specimens brought from the raised beach at Vardö as belonging to *Halichœrus gryphus* (Grey Seal), *Phoca hispida* (Floe Rat), *Gadus morrhua*, with *Buccinum undatum*, *Modiola modiolus*, and *Pecten islandicus*.

[3] *Ann. and Mag. Nat. Hist.*, ser. 4, vol. xx. (1877), p. 487; Nares' "Voyage to Polar Sea," 1878, vol. ii. pp. 341–342; *Quart. Journ. Geol. Soc.*, vol. xxxiv. (1878), p. 565.

Now, supposing what I saw happened, as it must often do, in the autumn, at the time of great snow-precipitation, this newly formed terrace would be strongly protected, and when the sea washed against it would rapidly be turned into ice, for snow absorbs sea-water with marvellous rapidity, and the terrace would be enveloped in a mantle as hard as glacier-ice. Supposing that this occurred accompanied by emergence of the land, we have found here one cause for rapid construction of terraces. That this does happen I have no doubt, for where I saw the terrace made, namely, between the Gosina and Kriva rivers, there were three other terraces standing behind this last-formed one. The oldest of these was apparently above the influence of present high tides, being about 100 yards inland, some 6 feet in depth, and possessing a perfect slope. For most of its extent this terrace was covered by a protecting mantle of névé, which was only bared at intervals; but in these places it showed perfectly regular terrace-structure.

3. Glacial Geology of the Kola Peninsula.

As we sail eastward along the Murman coast of Russian Lapland, we see on our right hand a bold and precipitous country. Its highest summits appear to rise to 500 or 600 feet. The hills are planed down to a general level, and no peaked mountain breaks the monotony of the scene. In bays and indentations immense raised beaches are noticeable, especially to the westward of Cape Cherni. Sviatoi Nos is the prominent headland which marks the entrance to the White Sea when approaching from the westward. This promontory forms the eastern side of Sviatonoskaia Bay, and the Ukanskoe River enters its south-western angle. Here the river is about half-a-mile wide, and is navigable for vessels of small draught for 3½ miles, when the rapids commence and the tidal influence ceases. From the entrance of the river to the rapids it is more correctly a fjord, flanked on each side by steep heights of granitic, gneissoid, and dioritic rock,[1] which rise to an elevation of 250 or 300 feet. A remarkable feature in this fjord is a ridge of large boulders which lines either shore to the height of 20 feet or more. It does not seem credible that tidal influence could have ranged the boulders in their present position, although the rise at spring-tides is 14 feet.

These boulders are of the same lithological character as the rocks in the neighbourhood. On ascending to the uplands from the banks of the Ukanskoe, an elevation of some 300 feet, we find a sombre grey, monotonous expanse of ice-worn land with hardly any surface-soil. There are hills and eminences and escarpments of rock, with undulations and swellings in this rock-surface, but the highest points are probably not more than 600 feet above sea-level, and 500 feet, measured by aneroid, was the greatest elevation that the writer reached. A remarkable and prevailing feature of the country is the vast number of erratic blocks spread over it in every direction. Standing on some eminence, we see around us countless boulders, all clad in coats of shaggy lichen, reminding one of Catlin's pictures of herds of bison resting on the prairies of the Far West. But our astonishment is increased when we examine them individually, and see the extraordinary positions that some of them occupy. Here a huge block resting on a couple of others, there two or three raised directly one upon another, again others standing as monoliths. From the descriptions of the distribution of erratics in Finland and Lapland by Durocher, Wraxall, Clarke, and others, I was prepared to see a remarkable number, but their dispersal over this portion of the Kola Peninsula excited my astonishment.

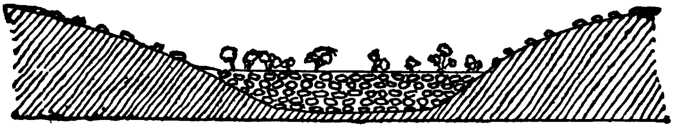

FIG. 1.—DIAGRAMMATIC SECTION OF BOULDERS IN HOLLOWS, NEIGHBOURHOOD OF SVIATOI NOS, KOLA PENINSULA.

When the eye becomes better acquainted with the positions of these blocks,

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[1] See Appendix by Prof. Bonney, p. 259.

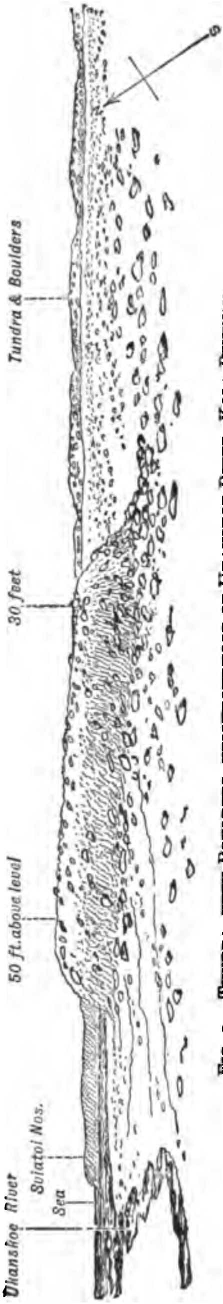

FIG. 2.—TUNDRA, WITH BOULDERS, NEIGHBOURHOOD OF UKANSKOE RIVER, KOLA PENINSULA.

certain salient features appear. Though they are spread generally over the surface of the country and lie broadcast on eminences and slopes, yet there is a tendency for them to collect in hollows and undulations of the surface. A notable feature in these aggregations is the entire absence of earth, clay, or sand between the blocks. As all these boulders are covered with a thick lichen-growth, I was unable to note whether they are grooved or ice-scratched. Fragments which I took from some of them are pronounced by Prof. Bonney to be fine-grained reddish granite, moderately coarse, rather felspathic gneissoid granite, a pale red gneissoid rock, granitoid or slightly gneissoid rock, and a dull red very fine-grained felspathic sandstone.

By referring to the valuable and exhaustive appendix of Prof. Bonney (p. 258), it will be seen that these erratics agree so closely in character with the rocks *in situ* of that part of the Kola Peninsula, that there can be little or no doubt as to their local derivation. The accurate determination of these rocks by so high an authority is of great importance. It presents strong evidence that there is no importation of foreign rocks among the vast accumulations of boulders on the Kola Peninsula—that no ice-sheet bearing its cargo of rocks from the north ever passed through Barents Sea, or impinged against the northern coast of Europe. It seems to me that in this local manufacture of erratics on the Kola Peninsula we meet with a striking example of the destructive powers of an ice-sheet resting on a comparatively level area.

Considering the tendency of the erratics on this part of the Kola Peninsula to accumulate in hollows and undulations of the surface, it appears that we have evidence pointing to a somewhat sudden recession or withdrawal of the ice-sheet. I do not accept a diluvial theory, such as a deluge sweeping the erratics into the undulations, but it seems probable that during the melting of the ice-sheet there was a tendency for the decomposing ice to drift the blocks into the hollows as we now see them. On the other hand, for all we know to the contrary, it may be incidental to an ice-sheet moving over a comparatively level land to push the boulders into depressions of the rock-surface beneath it. Only in one spot did I meet with a formation that had somewhat the appearance of a moraine, but as it consisted entirely of blocks, without any sand or smaller débris visible, it may be merely an accumulation of blocks formed under the ice-sheet. This mound stood on the edge of a ridge which looks down towards the valley of the Ukanskoe River: its elevation is 415 feet, and it runs nearly due north and south, is about a half-mile in length, and about 40 feet in height (Fig. 2).

Eastward of the estuary of the Petchora River the great Bolshaia Zemelskija tundra stretches to the base of the Urals, and along it we find proofs of elevation of the land in recent times. The Arctic explorer, Mr. F. G. Jackson, in his book "The Great Frozen Land" (p. 128), tells us: "We had been steadily travelling across the frozen tundra for eighteen days, when on the 1st November we crossed the Piatsoworyaha River, and on the following day, about 8 miles west of the river, entered a most interesting region. Right in front, and away to the northward, there spread the amphitheatre of an old bay, whose width would be about 15 miles, and its inmost reach at least 9 miles from the present sea-shore. Step above step there ranged the old sea-beaches, following the lines of the higher land immediately behind them, and girding with a terraced rampart the level basin of salt marsh into which the waves once rolled. The beaches themselves were now thickly covered with grass, and the grass with snow; but walking along the terraces, I found several pools of salt water, and a number of recumbent pine-trees—one of which I measured, to find it was 40 feet long, and 2 feet in diameter at the thickest end." From this it would appear that we are justified in assuming that the secular elevation of what is now the Bolshaia Zemelskija tundra was coincident with the emergence of the island of Kolguev, with its marine boreal beds now rising to a height of 250 feet above the sea. Further, I think that the cartographers of maximum glaciation in Europe should hesitate before extending an ice-sheet over that wide region lying between the Timan and Ural ranges, north of the Arctic Circle.

In order to connect our survey of the Arctic coast of Europe with the islands of Novaya Zemlya, I will again quote from Mr. F. G. Jackson, who, so far as I am aware, is the only educated person who has traversed the island of Waigats in its entirety, and his observations are of interest when taken in conjunction with mine on Gooseland in Novaya Zemlya. From Mr. Jackson we learn that there are two main ridges on Waigats, that on the eastern side composed of limestone and limestone-shale running in a north-west to south-easterly direction, and having a general elevation of from 150 to 300 feet, the other parallel to it on the western side of the island, but not rising higher than 70 feet. The intervening portion and the land bordering the sea he describes as tundra. Mr. Jackson writes:[1] "The tundra rolled away to the point, the ridges sometimes reaching a height of 30 feet above the intervening troughs. Along the lowest level of the troughs shallow pools and lakes were frequent. . . . Down in the troughs the soil was bluish mud . . . while on the ridges there outcropped the long friable sheets of limestone-shale which I found all over the southern part of the island and on the tundra around Habarova. . . . Round Dolga Bay (on the north-western side of the island) there is every evidence of the present shore-line being of comparatively recent existence. A raised beach about 12 feet above present level runs persistently along the cliffs."

4. NOVAYA ZEMLYA.

My personal acquaintance with Novaya Zemlya is limited. I have visited only a small portion of the western side of the south island, between the parallels of 71° and 72° lat. N. The appearance of this part of Novaya Zemlya is disappointing in scenic effects. There is nothing in its character approaching the grandeur of the western coast of Spitsbergen. Making for the shelter of Kostin Shar or Strait, that protected reach of waters lying between Mesdusharsky Island and Novaya Zemlya proper, we pass between low-lying Gooseland and Mesdusharsky. Their topographical features are quite distinct from those of the rest of Novaya Zemlya, and they appear to be long low tracts of tundra just rising above the sea and fringing the interior highlands.

In the vicinity of Rogatcheva Bay, where we made our first landing, the country rises abruptly from the shore to the height of between 500 and 800 feet, more or less. This hilly region, intersected by valleys with many lakes, extends for some 15 to 20 miles to the base of the interior range, which rises in a series of sharply peaked and serrated mountains averaging some 2000 feet in height. At the time of our visit, in the latter part of July, the land was generally clear of snow, little even remaining on the central ridges except in their higher valleys and gorges. I detected no glaciers on their flanks, and we saw no glaciers issuing into Kostin Shar.

The rock-formations of this part of Novaya Zemlya dip at very high angles, often nearly vertical, so that their outcrops appear as ridges. On all sides these are shattered and riven by frost, so that we walk over leagues upon leagues of splintered and shivered rocks. This is the work of frost and subaërial disintegration. I can see no evidence of the former extension of an ice-sheet over this area, no *roches moutonnées*, no glaciated surfaces, no rounded, mammillated, ice-worn contours. Had these at any time existed, one can hardly suppose that they could have been totally removed by the action of frost. I am making no reference to stratigraphical geology in this paper, but it may be mentioned that some five miles inland from Rogatcheva Bay I came across an outcrop of rock, apparently very similar to a characteristic series of erratics in the glacio-marine beds of Kolguev. It contains plant remains, and is probably of Jurassic age (see p. 261). It is quite within the range of reasonable assumption that a portion of the Kolguev erratics may have been floated from Novaya Zemlya.

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[1] *Op. cit.* pp. 31, 32, 37.

It is to Gooseland and the islands in Kostin Shar that I wish particularly to draw attention. The latter are worn down and abraded in contour, but as the rocks of which they are composed almost always crop out at high angles, and as they are very shaly in character and readily decay and splinter, no marks of glaciation are left on them. From Prof. Bonney's report they appear to be sedimentary rocks of Palæozoic or Archæan age.

All of these islands which I was enabled to visit have deposits of boulder-clay lying in their undulations and hollows. I met with sections showing a depth of 20 feet; the clay is of the same colour as the rocks upon which it rests, and the included stones are angular fragments of the same rock. I did not detect an erratic, or a rounded stone, or an ice-scratched stone in any of this boulder-clay. In many places it is full of shells of marine mollusca, *Saxicava arctica* predominating, though I found other species common enough. In some localities one might gather these shells by the bushel, few of them broken, never triturated, and in some cases the two valves are in contact.

This description holds good also of the part of Gooseland that I visited, the abraded ridges, the deposits of boulder-clay in the troughs, and the presence of shells of mollusca, all being characteristic features. As I have expressed a very decided opinion that no ice-sheet has ever extended over this part of Novaya Zemlya, I may be asked to account for the presence of these wide-spread deposits of boulder-clay, with the assemblage of the remains of marine mollusca in them. I venture to urge the view that the wearing down of Gooseland and the islands in Kostin Shar, and the deposition of the boulder-clay, are entirely due to the action of floating ice.

I pass on to give some examples which I witnessed of the force that floating ice can exercise. Last summer I was observing a narrow belt of floating ice

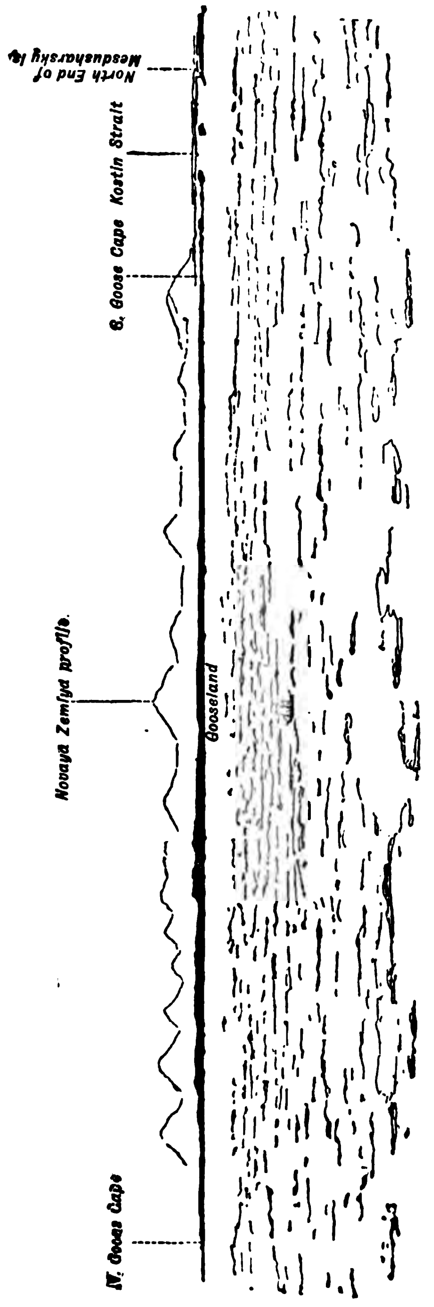

Fig. 3.—Sketch of Gooseland, July 4, 1895.

[We had run through forty miles of pack-ice, but found it impenetrable and wedged fast on Gooseland for ten miles, closing Kostin Strait, and belting round Meedusharsky Island.]

which for a few days hemmed in the western side of the island of Kolguev. This ice-pack was moving along the shore at the rate of three or four miles an hour. Some quarter-mile seaward from the beach on which I stood, lay a shoal under water. At this spot there was a constant turmoil and hubbub in the floating ice. The unusually heavy pieces grounded on this shoal, and for a short time checked the march past of the ice-column. The delay, however, was no long one; the pack accumulated behind, and by its pressure forced the lagging blocks over the shoal. As a rule, the accumulating pack dealt in a very summary way with the obstructionists, by passing under them and turning them upside down on the floe. The undersides of these blocks came up covered with mud and detritus from their contact with the bottom, and were swept onward by the ice-pack, their black colour being very distinguishable on the white surface of the ice-stream. Now, to force these blocks of ice, which were probably 8 to 10 feet in thickness, over an obstacle must require immense pressure, and it seems unreasonable to suppose that they do not exercise some abrading force; if not, why should the blocks have their under surfaces coated with material from the bottom? What I saw occurring at Kolguev on a small scale has doubtless been carried on extensively off the coast of Novaya Zemlya. Given a comparatively flat tract under water, such as Gooseland was, and a constant process of emergence, I see no reason why floating ice moving with a hundredfold greater velocity than a glacier should not be able to wear down ridges over which it passes, provided that the process of secular elevation is bringing the land and the floating ice into contact. The formation of boulder-clay, replete with mollusca, would be the natural sequence.

Next let us turn to a more distant part of the Polar area, where the powers of floating ice are witnessed on a much grander scale. In Smith Sound the fragments of the heavy floes of the Palæocrystic Sea are summer and winter endeavouring to work their way southward. Much of this ice is of stupendous thickness, floes 40, 50, and even 100 feet thick being met with. This vast body of ice, ever moving slowly southward through the strait, pushing over shallows, and rubbing and grinding against the shore, must surely be gifted with some wearing force. At headlands, or where the progress of this pack is interfered with, the enormous power of floating ice is exemplified. At such a point of pressure, the ice pushing against the shore exerts extraordinary force. An enormous mass of floe is brought to a stop against some part of the shore, while the check is transmitted to the ice pushing behind. The edges of these various floes are brought into contact with one another; they rise at their edges and crumble upon themselves, forming ridges of pressed-up hummocks 50 to 60 feet high. The pressure from behind forces the grounded floe to act in a similar manner against the shore. Slowly, as if urged by some hidden hydraulic force, the edge, impinging against the shore, commences to rear itself up in a chaos of ice-débris, and the blocks roll down on the floe or on to the shore. The portion that has grounded or been jammed against the shore being now pulverised, the obstruction is cleared, and the ice resumes its onward march. Is it possible that such pressure between land and floating ice can take place without some effects being produced? I think not, for at such points of contact, when we were able to reach them, we found the rock polished.

There are two or three islands lying along the eastern shore of Grinnell Land in Smith Sound, which offer some useful testimony, notably Norman Lockyer Island, which is encircled by several well-defined terraces or sea-beaches to an altitude of 300 feet. These terraces rest on rock-surfaces which show in places, where they are laid bare, ice-worn surfaces and striations. Now, as the striæ on the limestone rock of this island are as fresh-looking as if they had just been made, I am at a loss to understand how this can be, if they are due to the effects of land-ice. If so, how great the changes which these striæ must have encountered! First, what is now the waterway of Smith Sound must have been occupied by land-ice, then it must have disappeared, and the land must have sunk sufficiently at least to allow of the highest terrace being formed, which would be a submergence of 300 feet. Then followed a period of emergence, during all which time the island has been undergoing contact with floating ice, and yet we are asked to believe that the scratchings of the former ice-sheet have remained on the rock as fresh as they appear on the specimen that I have now in my hand! It seems more likely that the glaciation and striation went on simultaneously with the emergence of the island from the sea, and that they are the result of floating ice pushing over or along the island.

In Kostin Shar many of the islands and islets are connected by ridges, and frequently one is able to walk from one island to another over a causeway half a mile, more or less, in length. These causeways are covered with rounded stones and shingle, the pushed-up floe-ice lying on either side like the pictures of the "passage through the Red Sea" in the books of our childhood. If we examine such a causeway, we find that it has no character in common with a moraine, for the shingle is rounded by the action of the sea, and is only a few feet in thickness at the most, while in spots where the shingle does not lie the glaciated surface-rock appears. Now, when we reach the end of a causeway and the base of either of the connected islands, we not infrequently find the floe-ice pushing up the ridge and against the base of the island in a way that shows it to have a scarping and destructive force. (See Fig. 4, p. 253.) We can point as evidence of this to the pieces of rock and débris which have recently fallen from the escarpment of the island on to the ice-floe, and to disjointed pieces of rock ready to come away which are to be noticed at the meeting of the impinging ice and the abruptly rising land-face. Moreover, as I have already remarked, the surface of the ridge on which the edge or snout of the floe-ice is pushed up is glaciated.

I have seen similar glaciated, shingle-strewed ridges appearing above the sea, with the pack-ice grounded and pushed up on either side, in many other parts of the Arctic regions—Spitsbergen, for instance. I have in my possession a photograph of a well-marked ridge in Loom Bay, Spitsbergen (taken during Mr. B. Leigh Smith's voyage to that country in 1873), which that distinguished Arctic explorer gave me on his return. Being desirous of learning whether the views of that highly qualified observer coincided with my own, I recently communicated with him, and received the following reply:—

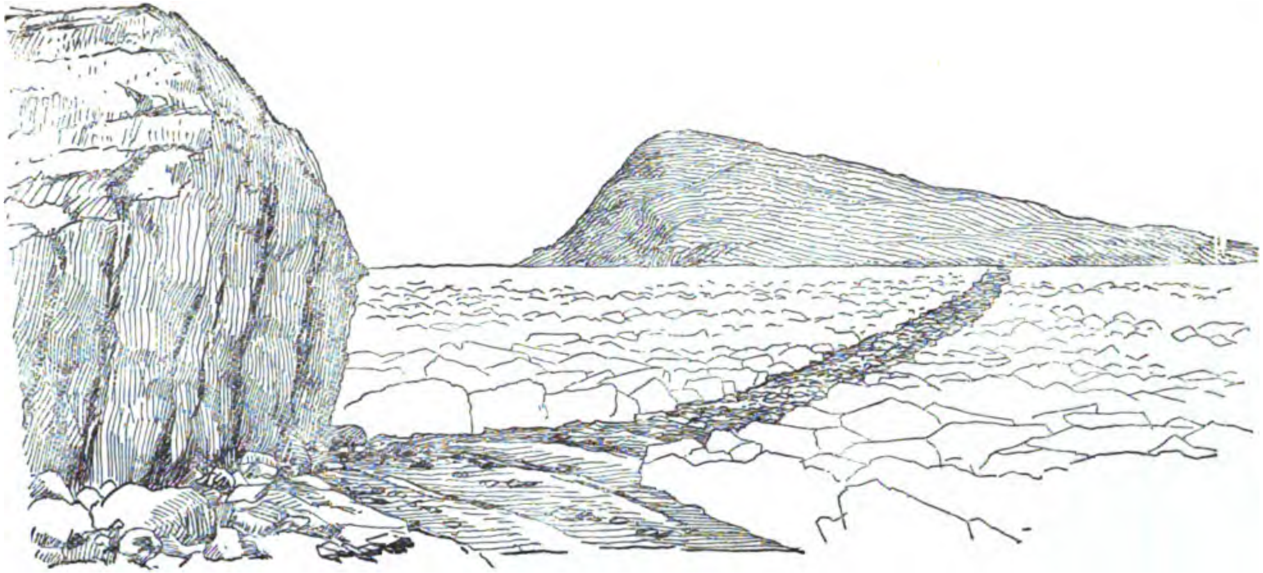

FIG. 4.—ISLANDS IN KOSTIN SHAR, CONNECTED BY A GLACIATED RIDGE OR CAUSEWAY COVERED WITH SHINGLE.

[The floe is shown pressing up on either side: at the left-hand corner the ice is pushing against the land.]

"I believe that the ridge in Loom Bay, Spitsbergen, of which you send me a sketch, was formed by the ice grounding on each side of a shallow, and forcing up the shingle from the bottom. There is a strong tide running into and out of Loom Bay. In Hinlopen Straits there are many low islands of columnar basalt which have been polished by the ice driving over them. I do not recollect whether the ends of these islands had been worn away or whether they were connected by ridges."

I have observed several minor phenomena connected with glacial geology in Novaya Zemlya on which I should like to make some remarks. First is a peculiar phase of rock-erosion which is visible at the entrance to the lake of Neckwatowa. The large lake of Neckwatowa, which is on the western side of Novaya Zemlya in lat. 71° 20′ N., communicates with the sea by a passage that has been cut through hard limestone rocks thrown up almost vertically. This channel is about a mile in length, and from 80 to 100 yards in width; the walls on either side are precipitous, and their height is 40 to 50 feet. There can be little doubt that the channel has been cut out by the water and ice passing from Neckwatowa Lake to the sea. It was noticed in passing through, that on both sides of this channel at the present water-line the rock is eaten away in the shape of a semi-culvert for six feet or so above present high tide mark. As the walls of the channel are of hard and homogeneous limestone, it looks as if the abrading agents had acted longer at the water-line than whilst excavating the higher part of the channel, and at the same time may it not point to a lull in the upward movement of the earth in this part of Novaya Zemlya?

A phenomenon observable in all Arctic regions whence the snow dissolves in summer has not, I think, received adequate explanation. It is that tendency of the surface-stones to arrange themselves most commonly in the form of hexagons. We see this on a small scale on Scottish mountains, and very commonly in Iceland. Paijkull refers to its occurrence in Iceland, and gives a sketch[1] illustrating this disposition of the stones on an Icelandic "Melr." His explanation is not altogether satisfactory, though it is founded upon that of so high an authority as Professor Steenstrúp, namely, that the earth, rendered soft by the melting of the snow in spring, has become dried by the heat of summer; that rifts or cracks are formed in it, and when a storm occurs the small stones that lie on the surface of the "Melr" are swept down into them. This explanation does not, however, account for their formation on the large scale met with in high Arctic latitudes. I have seen in Novaya Zemlya these arrangements of stones occurring in groups, the diameter across each enclosure reaching to several feet—the stones composing the enclosures being of considerable size, a foot or more square; the interior was occupied by a mound resembling a mole-hill. I think that the arrangement is unquestionably connected with the melting of the snow, but why the stones should be distributed as they are is not quite clear.

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[1] "A Summer in Iceland," p. 21, Eng. trans., London, 1868.

To another phenomenon that we observed on Gooseland we gave the name of "stone-bogs." Tracts of soft mud, in which a man sinks over the boot when walking, were frequently covered thickly with stones, so much so that we could walk in comfort over these treacherous spots for a hundred yards at a stretch. The stones moved under the tread, but did not sink. They lay on the surface of the quaking mud as smoothly as if a roller had been passed over them.

5. FRANZ JOSEF LAND.

We have evidence that secular elevation of the land is as recognisable a feature in Franz Josef Land as in other parts of the Polar area. Payer frequently mentions the raised beaches, visible on all sides, during his sledge journey up Austria Sound,[1] while the members of the Jackson-Harmsworth Expedition report that their winter house "is situated on a raised beach 115 feet above the sea."[2]

6. SPITSBERGEN.

Spitsbergen, especially its western coast, presents the most sublime and magnificent scenery that I have met with in Polar lands. Its western shore is as easy of approach in summer as that of Norway, and secure anchorages and harbours can always be reached. It is a land pre-eminently suitable for the study of glacial effects, for not only do we find there the forces of land-ice, but also, as it is an area of rapid emergence, the phenomena connected with glacio-marine action can be seen in progress. Along the shores of the great estuaries, such as Ice Fjord, old sea-beaches and terraces, containing the shells of recent mollusca in great quantities, are frequent. But the only novel observation which I have to record is that, owing to the rapid elevation of the land, we can examine in detail immense deposits originally formed under water in front of glaciers. These deposits in many cases now lie between the present shore-

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[1] "New Lands within the Arctic Circle."

[2] Montefiore, *Geogr. Journ.*, vol. vi. (1895), p. 507.

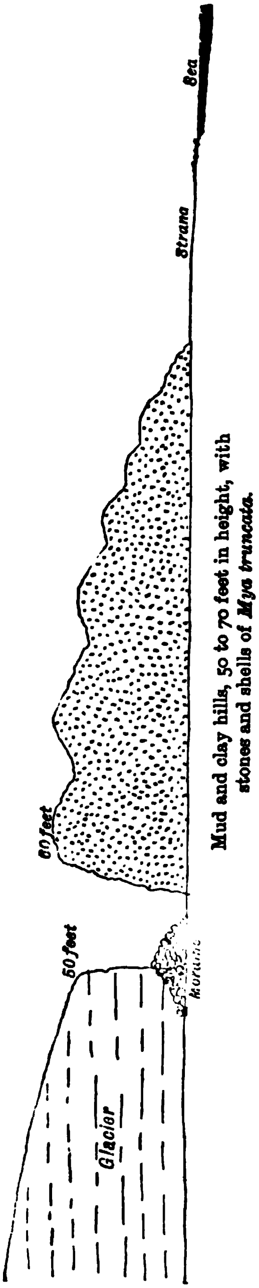
Sea
Strand
Mud and clay hills, 50 to 70 feet in height, with stones and shells of *Mya truncata*.
60 feet
50 feet
Moraine
Glacier

FIG. 5.—DIAGRAMMATIC SECTION OF GLACIER, MORAINE, AND MUD-HILLS AT THE HEAD OF GREEN HARBOUR, SPITSBERGEN.

line and the edge of the glacier of to-day, and their thickness and extent make them deserving of attention. A very notable formation of this nature is to be found at the head of Green Harbour, one of the minor indentations on the southern side of the Ice Fjord. The front of the glacier that now occupies the valley is about a mile distant from the present shore-line. Fronting this glacier, the terminal face of which is about 50 feet in height, and extending entirely across it for 1½ mile in length, is a range of low hills, some 50 to 70 feet high and half-a-mile in width. These hills have undergone much subaërial erosion, and channels have been cut in them by the numerous streams issuing from under the glacier. Following up one of these watercourses, which average from 25 to 50 yards across with a very level bottom, we find sections of mud and clay rising like walls on either side to a height of from 50 to 60 feet. These beds contain numerous stones, but neither they nor the stones themselves show any sign of stratification; in them I found shells of *Mya truncata*, but in no great quantity. That these beds are of submarine formation is confirmed by the existence of raised beaches in the neighbouring fjords, and along the adjacent line of coast, at a higher level than the beds which I am describing. Between the present face of the glacier and the perpendicular wall of the mud-hills runs a sort of ditch, dry moat, or open space some thirty yards in width, along the entire front of the glacier. The bottom of this ditch or moat is thickly strewed with morainic débris composed of rounded ice-worn stones, many being deeply grooved, scarred, and scratched. Through this slope of rocks and stones the glacier streams were pouring forth when I visited the spot in July 1894.

If the glacier, as it now does, can force this immense quantity of rounded and scratched stones from beneath it, the same process must have been going on when its snout was submerged in the sea. It seems to me that when emergence of the land is proceeding, as it is now in

Spitsbergen, there must come a period when the water at the face of the glacier shoals sufficiently to allow of the bay-ice which forms throughout the winter freezing deep enough to incorporate the boulders of the moraine. This being so, quantities of ice-scratched and ice-polished boulders, stones, and pebbles must be floated away on the breaking up of the bay-ice in summer. This would be a simple explanation of the occurrence of the vast number of scratched erratics which are to be found in the glacio-marine beds of Kolguev Island.

It is well known, and has frequently been remarked by travellers in Greenland, that in the neighbourhood of many of the glaciers discharging into the sea the water is discoloured with sediment, and contains a large quantity of suspended material. That this matter must in time be precipitated is evident; and when lifting the ship's anchor from the front of some of these glaciers (notably the Tyndall Glacier in Bardin Bay on the north-western side of Greenland), I have seen it come up with many pounds' weight of unctuous mud intermixed with sea-shells adhering to the flukes. It is therefore quite evident that water issuing from under a glacier in the Polar regions, and discharging from under the ice into the sea, can lay down glacio-marine beds in the ocean, and that the occurrence of ice-scratched stones throughout these beds can be accounted for.

My object has been to set forth the effects of glacio-marine action in the alteration of coast-lines, the deposition of boulder-clays, and the glaciation and polishing of rocks by floating ice. I have not alluded to the glacio-terrene geology of the Far North, as it would have extended this paper to unreasonable limits. I have endeavoured to avoid theories and hypotheses, and have confined myself to a bare narration of facts as I have observed them and as I understand them. Do not suppose that for an instant I compare the glacial effects of a continental ice-sheet as we find it now in Greenland, or as it formerly existed over a large portion of Europe and North America, with glacio-marine action; but undoubtedly the latter has been, and still is, a not unimportant factor in glacial geology.

In conclusion, I beg to thank Professor Bonney for his kindness in adding two valuable appendices to this and my former paper. His examination and description of these rocks, some of them from remote and inaccessible localities, are valuable in themselves; but I am most grateful for the light which they throw on the origin of some of the erratics that I have met with.

There can be no doubt that many of the erratics found in the glacio-marine beds of Kolguev are of precisely the same lithological character as rocks found in place in Novaya Zemlya, and we may presume with great confidence that they were carried thence by floating ice, and dropped to the bottom in that part of Barents Sea which has now risen into dry land. Again, it is extremely interesting to find, from Professor Bonney's investigation, that the vast accumulations of boulders on the Kola Peninsula are derived from local rocks, without, so far as we know, any foreign admixture.

REPORT ON SPECIMENS COLLECTED BY COLONEL H. W. FEILDEN IN ARCTIC NORWAY, ETC. BY Prof. T. G. BONNEY, D.Sc., LL.D., F.R.S., V.P.G.S.

In the following notes the specimens collected by Colonel Feilden are grouped according to localities, and arranged in the order of the dates on the labels.[1]

(i.) ROCK *in situ*, STOR TAMSÖ, PORSANGER FJORD, NORWAY.

(28.) A fine-grained, faintly speckled, light grey rock, apparently either a quartzose gneiss or quartz-schist, without strongly marked foliation. On examining a slice, quartz proves to be the dominant mineral. It occurs in rather elongated irregularly-outlined grains, which have borders of a different tint (crossed nicols). A dark olive-brown biotite is present in both fair-sized flakes and tiny flakelets, with some felspar, but much less than one would expect from the macroscopic aspect of the rock; there are also a few small garnets, a little iron oxide, and zircon. Macroscopically and microscopically the rock reminds me of some quartz-schists which I have collected near Braemar, Aberdeenshire, and in the neighbourhood of Clifden, Connemara.

(ii.) BOULDERS FROM TUNDRA IN THE NEIGHBOURHOOD OF SVIATOI NOS, KOLA PENINSULA.

(29.) A fine-grained reddish granite, rather rich in felspar and poor in mica (biotite and a little muscovite). Examination of the powder shows that some of the felspar is ferrite-stained, that microcline is present, and that the iron oxide probably is hæmatite.

(19, at Sviatoi Nós.) A moderately coarse, rather felspathic, reddish-coloured gneissoid granite; the biotite (not very abundant) exhibits a slightly linear arrangement. A good deal of muscovite is seen on close examination with a lens; this also is found in the powder, together with biotite and a very light brown mica, as well as plagioclastic felspar and microcline. The outer surface of the fragment has assumed in weathering a peculiar, rather lumpy, slightly glazed aspect. Possibly it may be part of a vein.

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[1] The numbers are those affixed to the specimens by Colonel Feilden. Sections were prepared for the microscope in cases where the rock seemed likely to be specially interesting. In other cases a fragment was powdered, and the material was mounted on a slide and examined.

(8.) A dullish red (slightly mottled) very fine-grained felspathic sandstone, with a few specks of mica, bearing some resemblance to Torridon Sandstone, but with smaller grains than is usual in that rock. Examination of the powder shows the quartz fragments to be angular in form and somewhat ferrite-stained, with plagioclase and microcline among the felspar, also a tiny chip of garnet.

(24.) A whole stone, labelled "miniature boulder," about 3″ × 1.75″ × 2.25″, rudely oblong, slightly tapering at one end. This appears to be a granitoid or slightly gneissoid rock.

(26.) An ovoid pebble, rather blunted at one end, of moderately coarse, pale-red gneissoid rock.

(16.) A fine-grained dioritic rock with a very slight approach to a foliated structure—felspar light-coloured, hornblende dark. Examination of a slice shows the following minerals:—(*a*) Green hornblende, strongly dichroic, with occasional inclusions (see 22, p. 265) in irregularly-shaped grains; (*b*) biotite in fairly idiomorphic flakes, often in close association with the hornblende, as if formed at its expense; (*c*) felspar—in quantity about one-half of the rock—in irregularly-shaped grains, being often moulded on the mica; occasionally slightly decomposed, much of it plagioclase, with both albite- and pericline-types of twinning. Sometimes a grain, which with ordinary light appears single, is found on applying the nicols to be composite. A few grains of quartz, granules of iron oxide, and several microliths of apatite also occur. The structure is peculiar: it may be the result of dynamic action, but there is nothing to prove this: possibly it is due to a partial fusion anterior to final consolidation, by which biotite has been produced at the expense of original hornblendic and felspathic constituents.

(iii.) ROCKS *in situ*, FJORD OF UKANSKOE RIVER, KOLA PENINSULA.

(20—At edge of water close to camp, June 24.) A rather coarse gneissoid rock, with some approach to a banded order in its constituents—like Archæan specimens from Greenland and Norway. Quartz, felspar, and biotite are readily seen. The powder shows the felspar (orthoclase probably predominating) to be rather full of minute enclosures; also very dark-coloured biotite, with some white mica, a little garnet, and (?) epidote.

(12—June 26th.) A rather coarsely crystalline, reddish granitoid rock, with much felspar. A slice shows the following minerals:—(*a*) Quartz in grains of moderate size and irregular outline, generally composite; in it hair-like microliths and small fluid cavities with bubbles are rather frequent. (*b*) Felspar in grains variable in size and interrupted by inclusions. Microcline is common, but the other grains, as a rule, show no signs of twinning. Occasionally they are rather decomposed, and contain many flakelets of colourless mica irregularly disposed. Also in parts towards the outside they seem to break up into a mosaic of granular felspar, with an occasional trace of micropegmatitic structure. The inclusions mentioned above are sometimes quartz, sometimes felspar, the latter seemingly a different variety. (*c*) A ferro-magnesian mineral, irregular in outline, inclined to be opaque, which in most, if not in all cases, is biotite. A small quantity of a light-coloured mica, which not improbably is a bleached biotite, also occurs. (*d*) In one part of the slice two or three small patches of a more decomposed mineral, intercrystallised with the felspar, suggest the possibility that a little elæolite may be present. There is a little apatite and hæmatite, and a grain or two of a colourless mineral, possibly andalusite. The mosaic structure in the quartz and the felspar is not improbably the result of some secondary change, perhaps due to pressure, but not to actual crushing. From the general appearance of this rock I should infer that it is of Archæan age.

(21.) A moderately coarse, rather felspathic granite. The powder shows quartz, felspar (orthoclase, microcline, and a little plagioclase), two kinds of mica, one being a dark biotite, the other (in small amount) having a very light-brown colour.

(22.) A fine-grained dioritic rock—felspar nearly white, hornblende (abundant) nearly black. Examination of a slice shows that rather more than half the rock consists of a rich green hornblende, which is strongly pleochroic, irregular in outline, including occasionally grains of water-clear felspar, iron oxide, and (?) sphene. Small cylindrical or plate-like inclusions of a dark brown colour also are frequent, like those common in diallage, hypersthene, &c., arranged parallel with the planes of ∞P. The intervals between the hornblende are occupied by small, rather irregularly-shaped grains of felspar, often water-clear (possibly in some cases quartz), together with a nearly colourless epidote. Both the hand-specimen and the slice exhibit a slight approach to foliation. A considerable amount of secondary mineral arrangement is suggested by the structure of the rock, but there is no definite evidence that this has been the direct result of pressure.

(iv.) ROCKS *in situ*, NOVAYA ZEMLYA.

(18—Vicinity of Rogatcheva Bay, July 17, 1895.) A very fine-grained, rather felspathic sandstone, of an olive-grey colour, somewhat carbonaceous and containing plant remains, very like those specimens from Kolguev Island described in a former paper (*ante*, p. 237). The powder shows quartz, angular chips of felspar (no evidence as to species), two or three flakes of mica (white and brown), and a grain of tourmaline.

Mr. A. C. Seward, M.A., F.G.S., who examined similar rock specimens from Kolguev Island, has kindly furnished a note on this one. He states that "the broader fragment (of a plant) may be a fern-rachis, but any trustworthy determination is impossible. The smaller needle-like fragments suggest either *Pinus* leaves or, perhaps more probably, leaves of *Czekanowskiana*, a fairly common Jurassic genus. Heer and others have described various species of the latter from Arctic plant-beds. The appearance of the rock and the fossils reminds me somewhat of specimens from Spitsbergen and Greenland which I recently saw in the Stockholm Museum, but my recollection of them is much too imperfect to be cited as evidence. On the whole, however, a Jurassic age seems to me the most probable."

(9—Basement-rock, Kostin Shar, July 17th.) A rather hard, very fine-grained sandstone, exhibiting well-marked current-bedding. The powder shows quartz, felspar, two kinds of mica, one grain which is probably tourmaline, and two zircons, slightly smoke-coloured.

(7—Kostin Shar, July 17th.) A dark greenish-coloured rock, the surfaces of which, though weather-stained, in places suggest a clastic structure. Examination of a slice shows the rock to consist of fragments, the interspaces being filled up by a carbonate (often calcite, possibly sometimes dolomitic). This is occasionally spotted with small flecks which polarise with varying intensity, and probably represent dust from the larger fragments. These fragments are both rocks and separate minerals. Of the former the majority result from the hydration of a basic glass, and the material may be now designated "palagonite." One of them exhibits a series of parallel wavy lines, like a fluxion-structure, sometimes (but not always) parallel with the exterior. The bands are composed of a minute green fibrous or platy mineral, the orientation of which is not always uniform. Its pleochroism is weak, its double refraction is feeble, and its extinction is oblique, but at a rather small angle; the mineral may be clinochlore. It also occupies what appear to have been small cavities in the rock. Embedded in the mass are small crystalline grains, often clustered, of a very pale brownish-buff mineral, with a rather granular surface, fairly high refraction, but not rich polarisation tints; their general aspect suggests a ferrous carbonate. One small fragment (with a few cavities) is full of minute lath-like felspars (the extinction-angle agreeing best with that of oligoclase), and resembles an andesite; another one is generally similar in structure, but the crystallites are even less distinct. Several "earthy" scoriaceous fragments occur; others, which are minutely granular in structure and of a brown or dark colour, may represent a sedimentary rock (varieties of indurated gritty mud). Among the mineral fragments are chips of quartz, often angular, retaining sometimes traces of a crystal face, but occasionally augmented by secondary deposit. Hæmatite is present, also (rather numerous) minute crystals of a brownish tint, with high refraction and rich polarisation colours, probably zircon. The vesicles in the fragments are filled either by the carbonate already mentioned, or (much more rarely) by a zoolite, which bears some resemblance to heulandite. It is impossible to say whether this interesting rock is a volcanic ash, or is mainly composed of volcanic material transported from no great distance; but I incline to the latter view. From its general aspect I should conjecture its age to be either early Palæozoic or very late Archæan.

(2, 3, 4—Island in Kostin Shar, July 19th.) Dull grey, fine-grained sedimentary rocks, consisting, probably, of quartz and more or less decomposed felspar, with a few flakelets of white mica. They are rather fissile, and in (2) the structure has the appearance of a true but imperfect cleavage. This specimen contains a few specks of pyrite.

(v.) ROCKS *in situ*, NECKWATOWA LAKE AND RIVER, LAT. 71° 20′ N.

These rocks are fossiliferous limestones, and they were accordingly submitted to Mr. E. T. Newton, F.R.S., who kindly examined those from Kolguev Island, and has favoured us with the remarks quoted below.

5, 17, 27 are from Maltzan Island in Neckwatowa Lake (July 20th). "They seem to be portions of the same rock. Upon their weathered surfaces are rod-like bodies, 1 to 2 millimetres in diameter, the longest of which measures perhaps 15 millim. This rock is so crystalline that microscopic sections fail to reveal any definite structure in these rods, although some exhibit indistinct radiating lines and others rather resemble *Amphipora*."

The other specimens, seven in number, are from the banks of the Neckwatowa River (July 22nd). "(10, 11, 14) contain portions of corals which, on account of their short septa, are thought to be *Amplexus* or some allied form. (25) includes a portion of a turbinate coral, a *Rhynchonella*, possibly an *Athyris* or *Spirifera*, and what looks like a fragment of a crinoid stem, having four divisions in the central aperture. (This specimen and No. 11 are labelled Iron Gate.) (6) shows indications of a coral, and perhaps also of a brachiopod; (31) contains remains of a coral; (13) includes a fragment of a stromatoporoid, possibly *Idiostroma* or *Amphipora*."

(vi.) Rock *in situ*, Loom Island in Kostin Shar.

(23—July 23rd.) The specimen bears a general resemblance to Nos. 2, 3, and 4, but it is a little more compact and darker coloured. It exhibits a slight fissility, but whether this be a true cleavage is doubtful. Some very faint markings on the surface may possibly be traces of an organism (? vegetable).

(vii.) Rocks *in situ*, South Gooseland, Novaya Zemlya, vicinity of Beluga Bay.

(1—July 24th.) A darkish, rather more carbonaceous rock than the last one, rudely fissile, as one may judge from the form of the specimen, which evidently was a loose flake.

(15—same date.) Another natural flake of a rock generally similar to the last, but darker in colour and rather more fine-grained.

(30—same date.) A similar rock, but still darker and more fine-grained.

These rocks (including 23) are not unlike some of the flaky or imperfectly slaty Palæozoic mudstones.

The collection indicates the presence of Archæan, Palæozoic (later and possibly earlier), and some Mesozoic rocks in the region visited by Colonel Feilden. The sandstone with plant remains appears to be identical with that from erratics in Kolguev Island. The fossiliferous Palæozoic limestone (though unfortunately its organisms are in worse preservation) bears a general resemblance to some of the specimens from that island, and the same may be said of certain of the crystalline rocks of Archæan aspect. Thus the Kolguev erratics may have come from Novaya Zemlya, including the adjacent islands.

APPENDIX F

NOTES ON THE GEOLOGY OF ARCTIC EUROPE AND ITS ISLANDS.

PART III.—DOLGOI ISLAND, WAIGATS, NOVAYA ZEMLYA, AND LÜTKE LAND.

BY COLONEL H. W. FEILDEN, F.G.S.

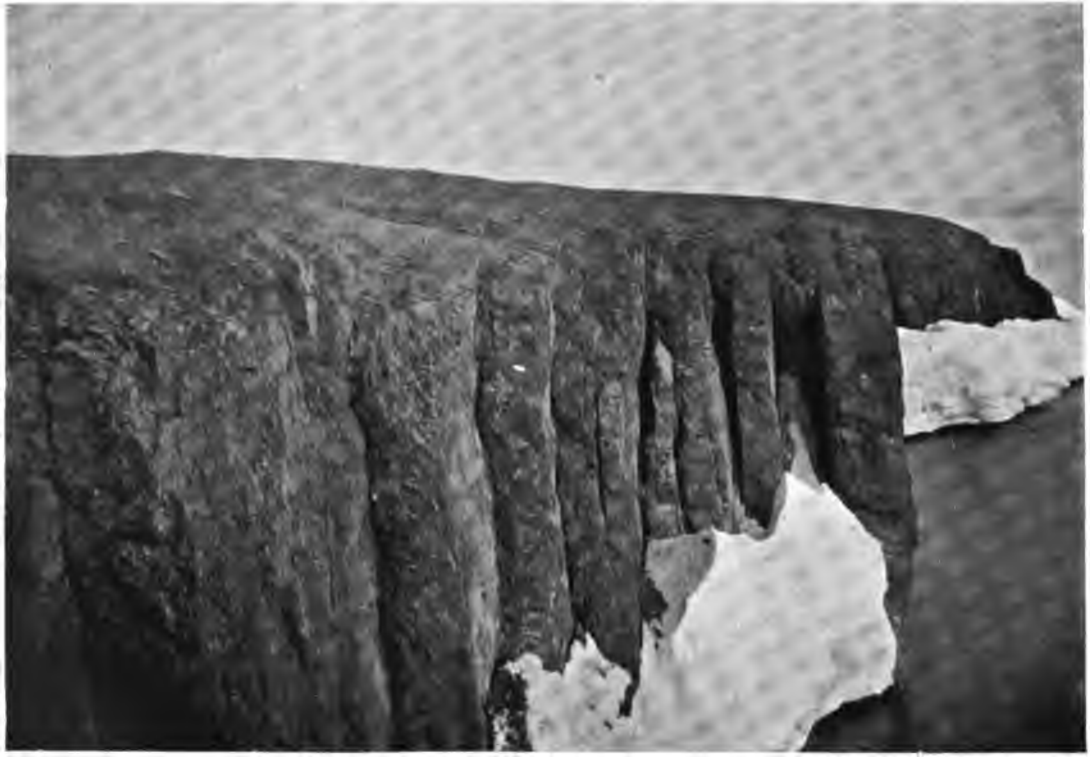
With APPENDICES by Prof. T. G. BONNEY, D.Sc., F.R.S., V.P.G.S., and Mr. H. S. JEVONS, B.A., B.Sc.; Mr. E. T. NEWTON, F.R.S., F.G.S., and Mr. JOSEPH WRIGHT, F.G.S.

INTRODUCTION.

SOME previous observations on the geology of Arctic Europe were published by me in the Journal of the Geological Society of London for the year 1896, and by the courtesy of the Council of that Society are reproduced in this volume. During the year 1897 I again accompanied Mr. H. J. Pearson to the Arctic regions of Europe, and the geological results obtained by that expedition are now published as subsidiary to the preceding papers.

I beg to express my indebtedness to Professor Bonney for his valuable report on the rocks, and to Mr. E. T. Newton for his paper describing the fossils obtained during the voyage; my thanks are likewise due to Mr. Joseph Wright, for his valuable contribution on the Foraminifera contained in the glacial-marine deposits of Arctic Europe; also to Mr. W. S. Bruce, who has kindly allowed his discovery in 1898 of carboniferous fossils at Cape Cherni, and their description by Mr. Newton, to be published in this paper. The rock-specimens submitted to Professor Bonney were, unless otherwise stated in his Appendix, taken from rock exposures in place, and were gathered, so far as my ability goes, to represent the prevailing rocks of the district. The absence of fossil remains recognisable by the unaided eye, from the vast series of Archæan and Palæozoic rocks met with, rendered it difficult to select hand-specimens which might establish with certainty the actual horizons in geological sequence to which the different rocks belong. But I think the reader of Professor Bonney's reports will feel satisfied that his critical examination of the rocks submitted to him, from many localities

PLATE 85.



11-7-97.

CLIFFS NEAR CAPE GREBEN, WAÏGATCH.

and over many degrees of latitude, confirm the general correctness of the views of previous investigators of the geology of Arctic Russia, along the Straits of Yugor, of the Island of Waigats, of Novaya Zemlya, and of Lütke and Barents Lands. That the prevailing rocks are Archæan, Silurian, Devonian, Carboniferous, and Jurassic seems to be established. It is remarkable that, so far, we have no indications of any Tertiary rocks in the wide area now under discussion, though so marked a feature in many other parts of the North Polar region.

The numbers attached to the rock-specimens described by Professor Bonney are based on the following arrangement, namely, commencing at the most southern station, Dolgoi Island, in 69° 15′ N. lat., then northwards to both sides of the Straits of Yugor, to the eastern side of Waigats, to the northern parts of the same islands, the western coast of Novaya Zemlya, both sides of the Matyushin Shar, and along the eastern shore of Lütke Land as far north as 74° 24′ N. lat. It may be noted that the expedition brought back rock-specimens from many stations extending over five degrees of latitude, and from some localities not previously explored.

The series of fossils submitted by me to Mr. Newton was very limited, and from only two horizons, viz., from Cape Greben, Waigats, 69° 41′ N. lat., a locality previously visited by Baron Nordenskiöld, and from the Pachtussow Islands on the east side of Lütke Land, in 74° 24′ N. lat. The determination of fossils from this locality is a distinct acquisition to our knowledge of the geology of Novaya Zemlya; whilst it is satisfactory to learn that Mr. Newton's determination of the fossils brought by me from Cape Greben confirms the views expressed by Nordenskiöld and Lindström as to their geological age.

Our acquaintance with the geology of Novaya Zemlya and Waigats is based on the discoveries and determinations made by the well-known Russian Admiral Lütke (1821–24); of the Russian naval officer Pachtussow (1832–36); of the celebrated v. Baer (1837); Thomas v. Heuglin (1870–71); the Austrian geologist, Höfer (1872); Baron Nordenskiöld (1875); Grinewezki (1877); Admiral A. H. Markham (1879); and by the scientific staff of the various Dutch expeditions ("William Barents," 1878–84).

It is unnecessary to enter here into details respecting the results obtained by these eminent explorers, as a valuable summary of the same was published in 1886 by Arthur Wichmann ("Zur Geologie von Nowaja Semlja").[1] It will be gathered from Wichmann's paper that the localities—where the age of the sedimentary rocks have been determined by their included fossils—are few and far between. Consequently, deductions as to the general geology of Novaya Zemlya and Waigats must to a large extent be theoretical.

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[1] Zeitschrift der Deutschen geologischen Gesellschaft. Berlin, 1886.

In addition to the above sources of information, I am deeply indebted to Mr. E. Delmar Morgan for having not only drawn my attention to the expedition of the Russian geologist, M. Chernysheff, to Novaya Zemlya in 1895, but for his kindness in translating that gentleman's report from the original Russian, and placing the translation at my service.

M. Chernysheff was appointed to the command of a scientific expedition to Novaya Zemlya in 1895. The object of the expedition was to study the orographical and geological features of the island-group north and south of Matyushin Shar, earlier expeditions having done but little more than survey the coasts. M. Chernysheff performed some notable explorations. With the assistance of dog-sledges he crossed Novaya Zemlya from the Russian station at Maly Karmakul on the west coast, reaching the shores of the Kara Sea in the vicinity of Abrosimov Bay. He investigated the mountainous region on the south side of the Matyushin Shar, around Pomorsky Bay, and surveyed a large extent of country from Nameless Bay, to Gooseland.

Did space permit, I should like to quote largely from M. Chernysheff's interesting report, but I only give his concluding paragraphs. "To summarise my remarks let me say, that from the time of v. Baer the opinion prevailed that the whole of Novaya Zemlya was an immediate continuation of the Pai-hoi range. This view has been confirmed as regards the southern part of this island (Novaya Zemlya), where the folding processes have undoubtedly followed a north-westerly direction, continued in Waigats and the Pai-hoi, at the same time parallel with the direction of the Timan and northern border of the Scandinavian-Kola *massif*. North of Nameless Bay we have another direction of the folding process, corresponding not with the Pai-hoi but with the Ural, and in Novaya Zemlya these two lines of dislocation meet in Nameless Bay, where a great upward thrust has been observed. The process of the formation of ranges ended in Novaya Zemlya with the Palæozoic epoch, and from that period this country has been the arena of denudation processes. Doubtless then were laid the beginnings of the transverse valleys dividing the whole system of the Novaya Zemlya ranges into distinct groups or masses. Matyushin Shar belongs to the number of these transverse valleys, though opinions have differed as to its origin. At the epoch of the great glaciation of Europe, Novaya Zemlya was covered by a continuous ice-cap, and whether we adopt the view that the enormous weight of this mass of ice caused portions of the earth's crust to sink, or whether we account for it in some other way, the fact remains that beyond all doubt Novaya Zemlya was submerged beneath the glacial ocean at an epoch contemporaneous with the submergence by its waters of vast tracts of Europe, Asia, and America. This submergence caused a diminution of the glaciers in Northern Novaya Zemlya, and freed the southern parts from them. About this time dates the formation of deltas, to which I have referred. Now the phenomena is reversed; Novaya Zemlya is rising, glaciers and nevés are growing in size, and if the process continues to a certain stage, the whole of Novaya Zemlya will be once more clothed in ice, and will present the appearance of an ice-desert such as we now see north of Cross Bay."

STRATIGRAPHICAL GEOLOGY.

The following is a short summary of the character of the rocks met with at the various localities I visited in 1895 and 1897:—

The geological structure of Dolgoi Island is simple. Both on its eastern and western sides the strata dip about 45° easterly; the strike is, roughly speaking, N.W. and S.E. The highest elevation of the island probably does not exceed fifty feet. The prevailing rocks are dolomitic limestones, containing a few indistinct organic remains, and brown and grey limestones more or less dolomitised. From the absence of recognisable fossils, I do not venture to define their exact horizon; but they are evidently of Palæozoic age, and probably Silurian.

In the vicinity of Habarova, on the south side of the Yugor Straits, the hills seldom rise to a greater altitude than seventy-five to a hundred feet. The marine boreal deposits are so widespread that rock exposures are not frequent, save as outcrops on ridges, in stream courses, and along the shore-line. The strata are nearly vertical, and the strike N.W. and S.E.; light-grey calcareous shales and grey dolomitic limestones are the prevailing rocks. Here again I failed to find recognisable fossils; but the similarity of the strata on both sides of the western entrance to the Yugor Straits is hardly open to doubt, and as the presence of Silurian rocks at Cape Greben is established, we cannot, I think, be far wrong in assigning the Habarova shales and limestones to the same geological period.

On the south shore of Waigats, opposite Habarova, the rocks exposed along the seashore are compact dark-grey limestones. Professor Bonney remarks that they are not unlike some from the Carboniferous system of England. At Cape Greben, on the south-west end of Waigats, are found dark-grey limestones; the strata are nearly vertical, and contain many fossils. On the eastern side of Waigats, in the vicinity of Cape Matiusela, the rock formations are argillite, grey dolomitic limestone, light-grey compact limestone, and dark-grey limestone; the strata are tilted at high angles, nearly vertical. These limestones from Cape Matiusela contain numerous Foraminifera,[1] and amongst them examples of the genus *Endothyra*, which, according to very high authority, does not occur before the Carboniferous period. If, on this evidence, we assign the Cape Matiusela rocks to that geological period, we are certainly not in harmony with the *Carte Géologique de la Russie d'Europe*,[2] which colours the eastern side of Waigats as Devonian. The north-western end of Waigats conforms in its general structure to the rest of the island. The rocks are thrown up at very high angles, generally near the vertical, and the lines of strike run N.W. and S.E., making low ridges, the highest not exceeding 300 feet. The prevailing rocks are dolomitic limestones and blue calcareous shales. Jackson Island, in the centre of Dolga Bay, is composed of dark dolomitic limestone, which Professor Bonney remarks is not unlike members of the Carboniferous system in England.

The Russian *Carte Géologique* colours the western side of Dolga Bay as Devonian, its eastern side as crystalline schists, serpentines, &c., stretching as a broad central band from the north to the south of the island. This is hardly borne out by an examination of the component rocks, which, on the eastern side of Dolga Bay and for several miles inland, are chiefly limestones and shales.

At Rogatcheva Bay, Novaya Zemlya, 71° 24′ N. lat., I met with an outcrop of fine-grained sandstone of an olive-grey colour, containing plant remains, which Professor Bonney and Mr. Seward are inclined to assign to Jurassic age. The various islets in the northern part of Kostin Shar are composed of very ancient sedimentary rocks, presumably Palæozoic or very late Archæan.

Around the borders of the lake of Neckwatowa fossiliferous limestones occur; Maltzan Island, in the centre of the lake, is of the same formation. Unfortunately the included fossils are imperfectly preserved, and no absolute determination of their age can be gathered from the specimens brought away by me. Around Beluga Bay, South Gooseland, we meet with extensive outcrops of flaky or imperfectly slaty mudstones, probably of Palæozoic age, and a series of grey felspathic grits, the strata being thrown up at very acute angles, often nearly vertical.

The Matyushin Shar, which separates Novaya Zemlya from the main island, is a valley of erosion, probably of great geological antiquity. The anticlinal and synclinal curves are exhibited on both sides of this channel in a series of matchless grandeur. In places, the mountains on either side rise sheer to heights of 2000

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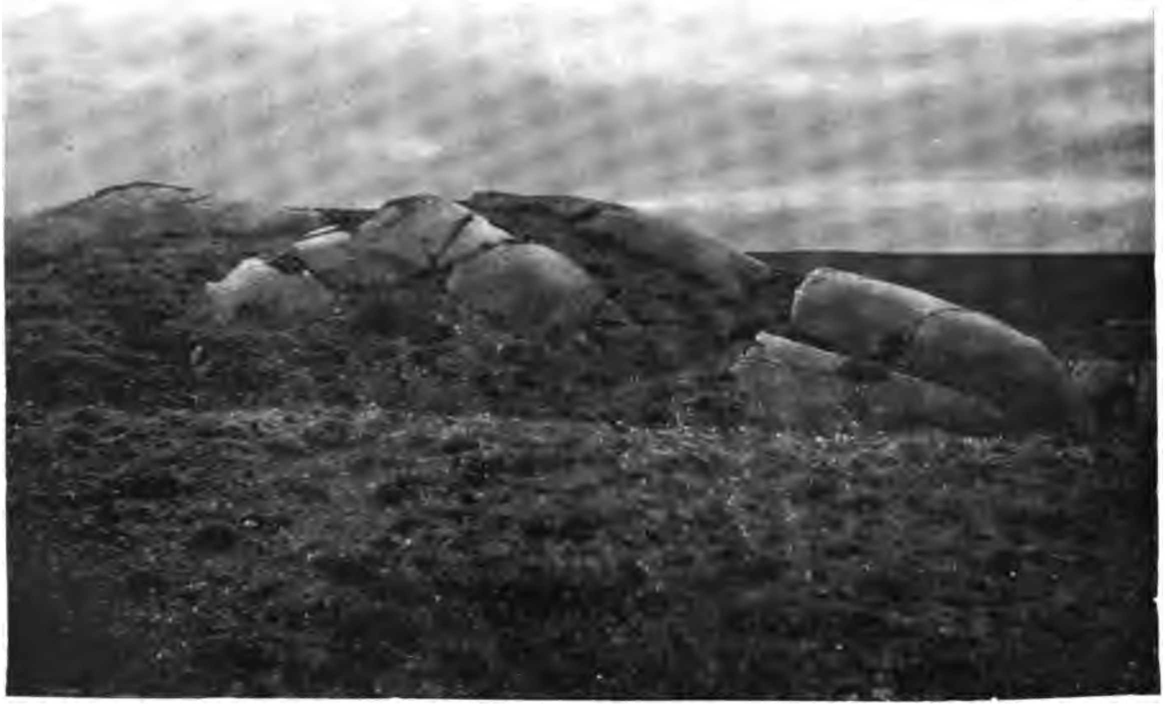
[1] See Professor Bonney's report, p. 277.

[2] Carte Geologique de la Russie d'Europe. St. Petersbourg, 1892.

PLATE 86.



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ICE-GROUND ROCKS NEAR CAPE GREBEN, WAÏGATCH.

feet. These rock-faces present the most wonderful undulations of the beds, forming crumpled folds, which appear on both sides of the Straits at precisely the same levels; every undulation of the strata, every curve being faithfully reproduced on both sides of the channel. The deepest soundings are found inside the channel, about midway, to as great a depth as 50 to 80 fathoms, whilst towards the western entrance the water shoals to 10 and 15 fathoms.

Inside of Beluga Bay, Lütke Land, 73° 15′ N. lat., and on both sides, we met with greenstones; whilst the rocks forming the hills around the anchorage of Seal Harbour consist of fine-grained dark-grey grits of Palæozoic aspect, often showing ripple-marks. At Gubina Bay, on the opposite side of Matyushin Shar, the predominant rocks are grey limestones. On the east coast of the North Island we find on the Pachtussow Islands, 74° 24′ N. lat., limestones containing fossils, which are reported on by Mr. E. T. Newton. The summit of a hill, 1400 feet high, on the mainland, in the same latitude, was found to be composed of a clay slate with fairly good cleavage.

GLACIAL GEOLOGY.

Under this heading I will confine myself more exclusively to observations on glacio-marine phenomena. The evidences of changes of level in the earth's crust are apparent throughout Novaya Zemlya, Waigats, and the tundra lands of Arctic Russia, and the results of a great marine transgression are manifest on all sides.

TRANSPORT OF MATERIAL BY FLOATING ICE.

In Dolga Bay, at the north-west end of Waigats, the pack-ice that, during July, came in under the influence of wind and tide, completely filled the bay; it was ice of one season's growth, much broken up, but bearing on its surfaces great quantities of mud, earth, stones, and gravel. This ice was evidently part of that great accumulation which forms every winter in the indentation of the mainland of Arctic Russia between the mouth of the Petchora and the Straits of Yugor. Much of it is river and bay-ice, and each summer, on its break-up, it drifts into Barents Sea and decomposes. We had skirted this drifting pack a few days previously, and followed its edge from the mouth of the Petchora to Waigats. The hot sun had dissolved much of the snow, and exposed the material resting on the surface of the ice, giving it a peculiarly dirty appearance. When we were surrounded by this ice in Dolga Bay, and had to traverse it to reach the shore, we were able the better to realise how enormous must be the amount of foreign material lying on the ice, and which is yearly transported from the continent to the ocean. I paced a piece of ice thirty by thirty feet, and I calculated that there was embedded and lay on it three barrow-loads of mud, gravel, and stones. On all sides the rotting ice was crumbling into the sea-water with a temperature of 40° F. and an air temperature of 60° F., and the mud and earth dissolving from the ice made the sea turbid. Now this process of discharging cargo to the bottom was not confined to the vicinity of our ship. Glancing over the wide expanse of Dolga Bay, with its covering of pack-ice, we could see from the dark patches that much of it was as heavily encumbered with foreign material as that around our ship. The quantity of earthy matter annually transported from the river-banks and lands of Arctic Russia into Barents Sea by the agency of floating ice must be enormous, and in the course of ages must have materially affected its depth. When we see such a transport of material from land to sea occurring in the course of one season, it is not difficult to understand how an island like Kolguev, showing 200 feet of marine-boreal deposits, has been formed on an area of upheaval.

Glaciation by Sea-Ice.

The island of Waigats offers an exceptional field for the study of the action of floating ice. There can be no question that the entire island has in very recent geological times emerged from the ocean, and has likewise participated in the marine transgression which involved large portions of Novaya Zemlya and the tundra lands of Arctic Russia and Siberia. In its extent of some sixty miles in length by some twenty in breadth, there are no mountains; probably its highest ridges do not exceed 300 feet, whilst, as a rule, they are much lower; the troughs and valleys are very often filled with marine-glacial clay of the same character as that now forming under water in the bays and around its shores. These deposits on the land contain molluscan remains and tests of foraminifera of the same species as we now dredge up from the neighbouring sea. At the present day no permanent snow or ice remains on Waigats, nor are moraines to be met with, nor any signs of rock-glaciation by land-ice which might not plausibly be assigned to glacio-marine action.

We meet, however, with rock-glaciation on the summit of ridges, not persistently, for the splitting limestones and crumbling shales of which they are made are liable to sub-aërial destruction, and consequently to the removal of ice-polish. But sufficient signs remain even on the top of the ridges to show that the entire island has been subjected to glaciation by ice in one form or another. At lower altitudes we may observe the rounded ice-polished basement rock standing up from the marine-boreal clay of the tundra like rounded ice-worn skerries from the sea. The accompanying Plate, 86, gives a better representation of a case in point than any description by words. When we stand on the seashore, we find precisely the same polishing and rounding of the rocks and islets as we may observe on the ridges, only the polishing at the tide-line and below the water is of a more general and apparently more recent character than that which we meet with on the higher ridges of the island. The polishing of the hard Silurian limestone on which the beacon at Cape Greben stands is a good example of the rounding of much of the present coast-line of Waigats.

That the polishing and rounding of the present coast-line and islets off Waigats can be accounted for by the action of floating ice is my opinion. When anchored in Dolga Bay, some small islets in the neighbourhood gave us great protection from the incoming pack-ice, much of which, as already mentioned, was plentifully charged with gravel and stones. With wind and tide in its favour, this ice pressed and squeezed against these islets, forming pressure ridges and hummocks which pushed up their slopes and then slid down again with roar and crash. It forced itself between narrow channels and gaps between the rocks with such persistency that it overstepped the water-level by several feet. On examining the points of contact between the ice and the islets, we found the rocks both below and above the tide-line highly glaciated and scored, whilst the sides of the narrow gaps between the islets showed similar results. These marks of ice-action are obviously produced by the floating ice, because higher up the sides of the islets they decrease in intensity, and on their summits are nearly effaced through the decay and splintering of the rock itself. Had this rock-grinding been the result of a former ice-cap, we might with good reason expect to find it as much in evidence on the higher ridges as at the present shore-line. On the eastern side of Waigats, exposed to the full weight of the Kara Sea pack, the shore-line of rocks is intensely glaciated; mounds of gravel and rocks, with driftwood thrust up many feet beyond tide-line, testify with what prodigious force the on-shore ice is propelled. The basement rocks, over which these mounds of gravel and stones have passed, are polished and striated. If we claim that the glaciation of the island of Waigats is the result of ground-ice, we have to admit that such glaciation must have taken place prior to the submergence of the present island, and the marine transgression which has filled up its valleys with boulder clays and mud and sand-beds which at Cape Matiusela reach the imposing thickness of 100 feet or more of marine-boreal deposits. I therefore find it difficult to escape from a process of reasoning which ascribes a common origin to phenomena visible on the land, and to similar ones now in progress at the shore-line and in the surrounding sea.

ELEVATION OF LAND EVIDENCED BY SEA-BEACHES.

Along the shores of Arctic Russia, over Waigats, along the western shores of Novaya Zemlya, on both sides of the Matyushin Shar, and the eastern coast of Lütke Land, we find raised beaches. But these remarks will be confined to a description of those that occur around Beluga Bay of the Matyushin Shar, and on both sides of the eastern outlet of that remarkable strait. For we stayed some time in that vicinity, and had better opportunities of examining them in that area than elsewhere.

Cape Vuchadnoi, which marks the eastern entrance to the Matyushin Shar from the Kara Sea, is a bold promontory, built up of four or five stupendous sea-beaches. The highest is about 500 feet, and they are separated one from another by slopes of about 100 feet in height, with broad and level terraces between them. A similar series of terraces on the same colossal scale is to be observed on the opposite or south shore of the strait, and these can be traced at intervals for many miles inside of the Matyushin Shar. At Beluga Bay, which runs several miles into the interior of the North Island, similar great terraces are displayed on its eastern side. The 500-foot terrace can be traced for miles around Beluga Bay. At this elevation we met with sections caused by streams cutting through the terrace, where accumulations of shells were visible, chiefly *Saxicava arctica* and *Astarte borealis.* The 100-foot terrace which winds round the hill-sides of Beluga Bay is especially interesting, as it has a common origin with a series of outliers in the shape of rounded hills and eminences, now detached to some distance from the line of terrace, and bordering the present sea-shore. Northwards from Seal Harbour, the first of these eminences rises by the seaside as a round grassy knoll, but on the sea-face the waters have denuded it, and expose an excellent section. It is exactly 100 feet in height, is composed of rounded stones, sand, and gravel, and formed of precisely the same materials as the terrace skirting the slopes of the hills at a quarter to half a mile distant. Several other similar hills are to be seen along the eastern shore-line of Beluga Bay, between Seal Harbour and Freddy Straits.[1] If their origin was not so patent, we might have confounded them with eskers.

At elevations up to 1000 feet on the hillsides bordering the Matyushin Shar, we came across patches of rounded water-worn pebbles, that seemed to be remnants of still loftier sea-beaches, but they were so overwhelmed by the screes falling from the upper parts of the mountains, that we did not succeed in tracing

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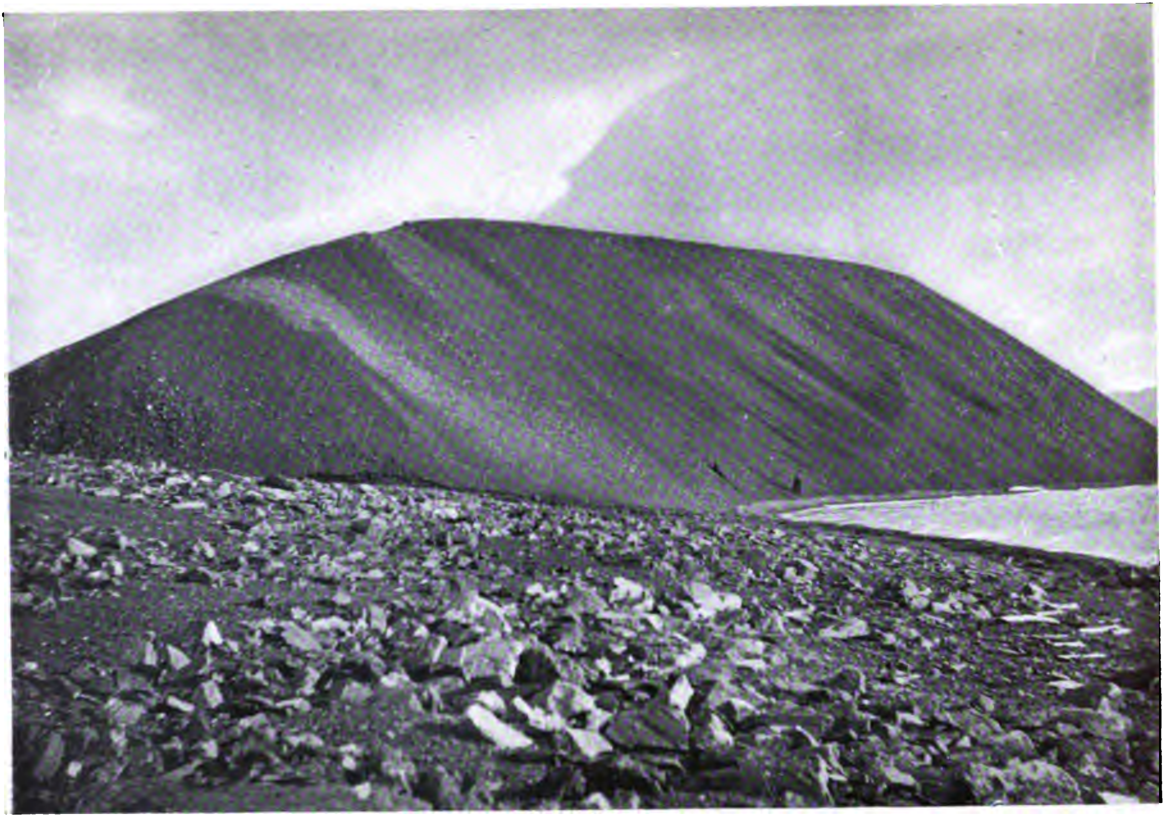
[1] Chart No. 331, Hydro. Office, Washington, D.C., 1872.

PLATE 87.



F. 11. 1/5 *S.* 5.45 *p.m.* 31-7-97.

MOUND OF DEBRIS, 100 FEET HIGH, IN BELUSHJA BAY.

them for sufficient horizontal lengths to afford actual conviction. It is a very remarkable fact that the medial moraine of the Ibis Glacier in Ziwolka Fiord is largely composed of water-worn pebbles as round as golf-balls. We noticed that five black peaks rose some ten miles inland out of the *mer de glace*. From each of these hills trickled a dark stream of debris, which, coalescing, formed the medial moraine. The water-worn pebbles undoubtedly came from these Nunataks. It appears probable that the glacier was eroding old sea-deposits, and transporting their rounded pebbles over the glacier. These Nunataks cannot be less than 1000 feet above the present sea-level. Though the suggestion that recent sea-deposits occur over Novaya Zemlya at 1000 feet above the present level of the sea is not fully confirmed, yet it remains an indisputable fact that the entire island group has been raised above sea-level at least 500 feet in recent geological times. In other parts of the Polar regions the changes of level are equally marked, for in Grinnell Land post-tertiary deposits are widely developed at altitudes of 1000 feet.

DERIVATION OF RAISED BEACHES FROM DELTAS.

As the formation of terraces similar to those at higher levels around Beluga Bay is now in progress, it may be well to refer to the process of their construction. In Novaya Zemlya the denudation of the higher lands is out of all proportion to the magnitude of its rivers and streams. At the commencement of the annual thaw, the rotting snow-sheets on the sides of the mountains, with the water, come down in floods and torrents, carrying with them enormous amounts of frost-splintered rocks, earth, and stones. In the valleys of Novaya Zemlya we meet with accumulations of material discharged from mountain gorge or cleft, stretching at right angles across the trend of the main valley. Stupendous indeed are some of these aggregations of water-borne materials. The height of one on the north side of the Matyushin Shar, which, coming from a mountain gorge, impinged at right angles against the moraine of a great glacier, was 800 feet. This was built up of a chaos of sharp-edged rocks and splintered stones. There, in close proximity, were seen the moraine of the glacier and the moraine of the *debâcle*.

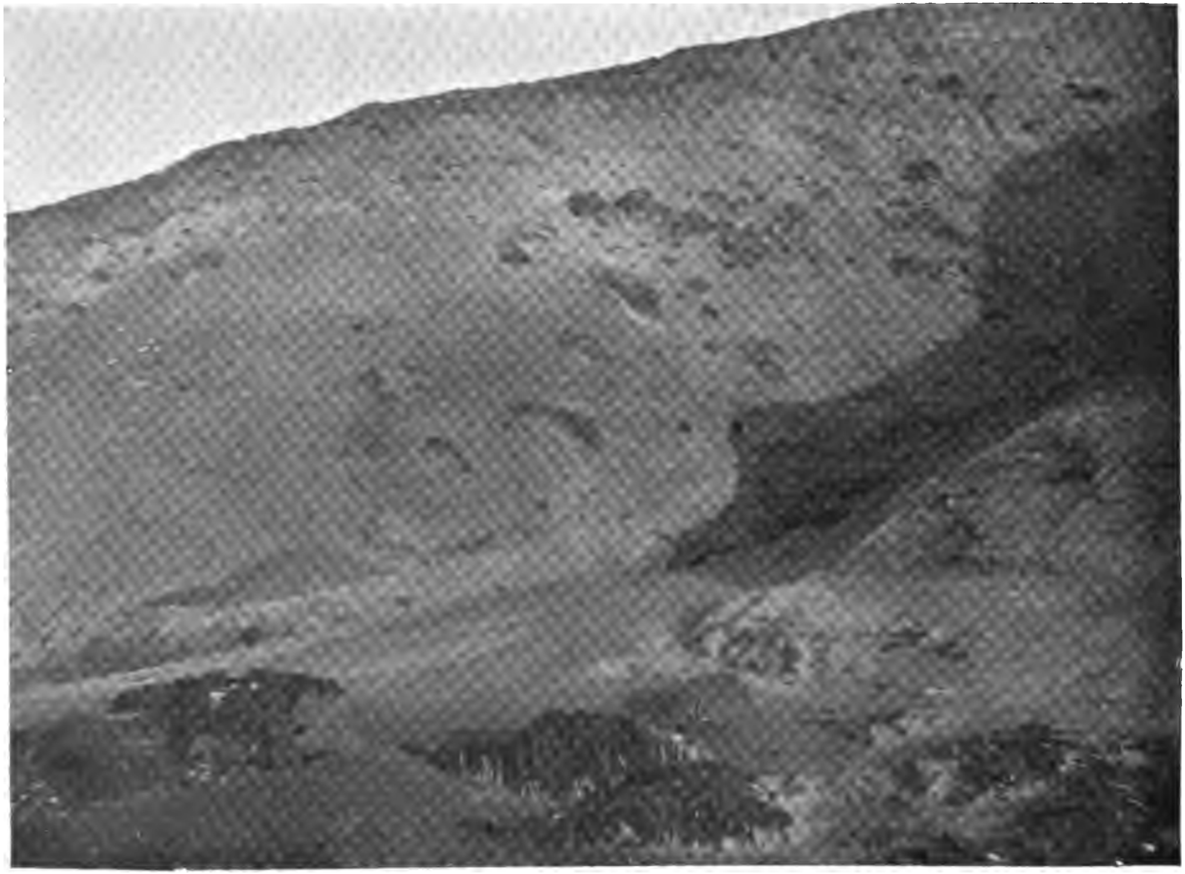
So enormous are the products from denudation of the mountains, that we find deltas of stone and gravel and sand forming at the mouths of nearly every river and stream in Novaya Zemlya. These deltas encroach on the sea, and spread considerable distances, may be a mile or more, laterally along the present shore-line. They are quite flat, and their thickness depends on the depth into which the material is deposited. To cite an example, our ship lay alongside one of these deltas to take in fresh water. Her stem was run obliquely into the shore, which at that point was a delta terrace, one foot above high-water line; at the stern we measured a depth of 10 fathoms, and the slope of the terrace showed as plainly under the water as that of a railway embankment on land. Presuming the upward movement of the land continues, this delta would in the course of time appear as an elevated marine terrace. So precisely do the deltas of to-day conform in their position and structure with the elevated terraces of Beluga Bay, that it is impossible to doubt that they were all formed under the same conditions. Sections of these terraces, some 100 feet thick, show them to be of a very homogeneous structure of sand, gravel, rounded pebbles, and rounded stones; they present no signs of stratification, though they are mixed materials deposited on a large scale in shallow waters and exposed to the tides of a Novaya Zemlya fiord.

MARINE BOREAL DEPOSITS.

The marine boreal deposits met with in our explorations of Arctic Russia and its islands seem to resolve themselves naturally under three heads, viz.:—

Cape Matiusela Beds.
Grey Foraminiferal Clays.
Delta Beds.

At Cape Matiusela, on the east coast of Waigats, we meet with great deposits of sand and clay, superimposed upon the dolomitic limestones, which there form the coast-line. These beds were followed by us for several miles on both sides of the cape. How far they extend inland we had no means of ascertaining. At the shore-line these beds have been considerably denuded by water running from the tundra land, and fringe the coast as a range of low hills, 50 to 100 feet in height. The sections we examined showed no definite signs of stratification. In this respect they agree with similar beds in the island of Kolguev, likewise in the number of large ice-polished boulders which both contain. Some of these in the Matiusela beds are of great size. One in particular, an almost perfect sphere of biotite granite, standing as high as a man, attracted special attention from its warm reddish-yellow colour and beautiful polish. We found no shells of recent mollusca in these beds, but in samples submitted to Mr. Joseph Wright, that gentleman detected foraminifera and sponge spicules, the latter in abundance. From the absence of stratification, and the way in which the erratic blocks have



F. II. 1 *S.* 8.45 *p.m.* 18-7-97.

SAND CLIFF, 115 FEET HIGH, NEAR CAPE MATINSELA.

been distributed throughout the mass, I gather that the deposition of the material took place in a sea deep enough to be removed from the influence of tides. These Matiusela beds pass by almost imperceptible gradations into the grey marine clays, with shells of recent mollusca, that now form the surface of the present tundra-land. It appears to me that these Matiusela and Kolguev beds, with their very mixed assemblage of erratics, represent deposits laid down at the period of maximum depression of that area during Post-Pliocene times, and the consequent destruction and floating away of much of the Novaya Zemlya glaciers and moraines.

The grey foraminiferal clay is the most widely dispersed deposit. We find it spread over the tundra land of Arctic Russia, over Waigats, and over Novaya Zemlya, where it is to be met with in valleys and the slopes of hills up to an altitude of at least 500 feet, always forming the surface layer. Throughout its distribution it is very homogeneous in character. Precisely the same clay comes up in the dredge or on the flukes of the anchor in the Straits of Yugor, in Dolga Bay, and other anchorages on the coasts of Waigats. When brought up from the bottom of the sea, it is an unctuous mud; in the land deposits it turns into a stiff tenacious boulder clay. It is in this deposit that shells of recent mollusca frequently occur, and every sample that has been examined by Mr. Wright shows that it is rich in the tests of foraminifera.

I have already referred to the Delta beds, and will now merely mention what appears to be a proof of how rapidly they may be laid down. The chart issued by the Hydrographic Office, Washington, 1872, gives a plan of the survey of Beluga Bay by the Rosenthal Expedition in 1871. In this plan the upper reach of Beluga Bay, named Meta Bay, is marked with soundings of 7, 8, 10, 11, 12, and 15 fathoms. Meta Bay is about three miles in length by about two in width. In 1897, only twenty-six years after that survey, we were unable to navigate its waters in a steam-launch drawing three feet of water. If the soundings on the American chart are correctly given, this is a remarkable instance of a bay filling up in so short a time with the material brought down by the mountain streams that discharge into it. Neither does it appear that elevation of the land in the interim can be invoked as a factor, for the following reason. Rossmyssloff, the Russian explorer, wintered at Seal Harbour, at the entrance to Beluga Bay, during 1768–69, and the foundations of his winter hut are now to be seen on a flat stretch of shingle, about one foot above present high-water mark. This points either to a lull in the process of upheaval, or that the epeirogenic uplift is slow indeed, measured by the chronology of man.

FORMATION OF STONE HEXAGONS.

I obtained in Waigats a satisfactory solution, at least to myself, how, under certain circumstances, hexagonal "stone-walls" are formed. Standing on the edge of a ridge of rock, and looking on the thawing, glacio-marine clay below, which sloped gently towards the centre of the valley, one might observe that the scree, composed of fragments of rock fallen from the cliff, does not move forward over the clay in a sheet of debris, but takes definite parallel lines of advance. That is to say, lines of rocks and stones advance at right angles from the base of the scree, perhaps five to ten feet wide, and separated from one another by intervals of the same width. As these lines of rocks and stones move downward over the semi-liquid clay they become attenuated and advance in single file, and as the tundra becomes more of a level, the process of advancing in column at right angles from the scree stops. The lines of stone curl inwards and inosculate, forming round rings of rock and stone, five, ten, twenty, thirty feet in diameter, so that the tundra becomes packed with circles of stones, each with a hillock in the centre. Where these stone circles coalesce, they naturally assume a hexagonal shape, and give the appearance of gigantic honeycombs spread on the tundra.

CONCLUSIONS.

I will not enter here into the questions whether the great marine transgression over Arctic Europe was contemporaneous or not with the period of maximum ice-development in Northern Europe, or whether the sinking of wide land areas beneath the sea dissolved an ice-cap, or whether, indeed, an ice-cap ever lay over those regions. These are all debatable theories, and so far I have endeavoured to confine these notes to a record of personal observations. There is one point, however, to which I desire to draw attention, namely, that the emergence from the sea of a large part of Arctic Russia, Waigats, Novaya Zemlya, Lütke, and Barents Lands, must have been an important factor in ameliorating the climate of Northern Europe. When these lands were submerged beneath the water of the boreal sea—and Novaya Zemlya itself only showed as a group of islets—the ice of the eastern Arctic seas would press on to the shores of Lapland and Norway, as the ice of the Kara Sea now does against the eastern shores of Waigats and Novaya Zemlya. The subsequent upheaval of these lands, and the formation of a nearly continuous breakwater of six or seven hundred miles, extending north and south into the Polar Seas, and diverting the ice-drift, must have far-reaching results on the climate of North-Western Europe.

REPORT ON ROCK SPECIMENS COLLECTED BY COLONEL FEILDEN IN NOVAYA ZEMLYA, ETC., 1897. BY PROF. T. G. BONNEY, D.Sc., LL.D., F.R.S., V.P.G.S., AND H. S. JEVONS, B.A., B.Sc.

1, 2. ROCK *in situ*. East side of Dolgoi Island. Dip very regular, 45° E.

A brownish-grey limestone containing many minute black specks. These and the colouring matter disappear before the blow-pipe, so both are of organic origin. A slice from No. 1 shows a composite structure of rather irregular shaped grains and muddy-looking granules. The former are more or less dolomitised, and rhombohedra of dolomite can be often discerned; the granules on examination appear to be mostly, if not wholly, fragments of calcareous organisms. Few, however, exhibit any definite structure, but some of the spherical or ovoid bodies (rather small), described under No. 16, can be recognised, and one or two chambered foraminifera. There are also one or two crinoid (?) fragments, and ostracods, with a few tubes.

3, 4, 5, 6, 7, 8. ROCKS *in situ*. West side of Dolgoi Island. Dip 45° E., very regular.

These specimens consist chiefly of a grey finely crystalline dolomitic limestone, with numerous crystals of dolomite scattered about the surface in places, and on one specimen (No. 3) some distinct crystals of calcite. The specimens are well weathered, and present a very rough appearance owing to the presence of some thin, irregular, more or less silicified bands of a dull brown colour. In places these projecting bands sparkle with very minute crystal faces.

Two of the specimens exhibit very peculiar structures, tubes of siliceous material, about 2 cm. in diameter and 10 cm. in length. They are open at one end, but at the other taper rather abruptly like a belemnite, as is well seen in one specimen broken so as to give a longitudinal section. The internal wall, viewed from the open end, is a cone only about 4 cm. deep, the end being slightly bent over to one side. The extension of this appears to form a solid core reaching to the tapering end. Concentric layers of a siliceous deposit are visible for a distance of 6 mm. outside the main shell. We cannot offer any satisfactory explanation of these structures.

Most of the specimens have a slight green staining, which may indicate the presence of copper.

9. Rock *in situ*. Not far from sea, three miles west of Habarova, Yugor Straits. Strata nearly vertical.

A soft, light grey calcareous shale, breaking rather irregularly, but not so as to suggest the existence of a cleavage. Before the blow-pipe it turns a little lighter, but redder, in colour, so that probably the colouring matter is mostly carbonate of iron.

10. Calcite *in situ*. Habarova.

A lump of milky-white calcite, showing the usual rhombohedral cleavage, about 10 cm. long. Probably from a vein.

11. Rock *in situ*. Range of hills, 150 feet high, six miles west of Habarova. Strata nearly vertical.

A compact, slightly reddish, light grey limestone, showing on weathered surfaces very fine parallel slightly wavy striations, probably indicating mechanical disturbance. Entirely bleached before the blow-pipe. A slice shows it to be a dolomitic limestone, consisting of angular grains embedded in a streaky micro-granular matrix with a structure resembling that of some foliated rocks. It has probably been a rock, more or less resembling some of the above, which has been much crushed. One part of the slide, less disturbed than the rest, apparently retains traces of organisms.

12. Rock *in situ*. South end of Waigats, opposite Habarova.

A compact dark grey limestone, with rather rough fracture; not unlike some from the Carboniferous system of England.

13. Rock *in situ*. Cape Matiusela, Waigats.

A dark, slightly purplish argillite with irregular cleavage, possibly nearly coincident with the bedding.

14. Rock *in situ*. Cape Matiusela, Waigats.

A sub-crystalline or finely crystalline grey dolomitic limestone, weathering to a lighter grey colour with a slight reddish tint. The rock is much fissured, the cavities having been partially filled with small crystals of dolomite and a little quartz. Possibly of palæozoic age.

15, 16. Rock *in situ*. Cape Matiusela, Waigats.

These specimens both consist of light grey compact limestone with a rough fracture and some traces of fossils A slice from No. 16 shows slight signs of pressure and exhibits fragments of organisms, cemented by fine-grained calcite. The structure of these is apt to be more or less obscured by subsequent mineral change, but the largest are pieces of coral, apparently elongated chips from the theca, and once or twice possibly a septum, while in one case portions of tabulæ may remain. A few of the fragments are water-worn, but they generally are angular and elongated, the majority (but not all) lying with a rude parallelism. Foraminifera are not rare. We recognised among them an *Endothyra*, resembling *Bowmani*, as figured by Mr. H. B. Brady,[1] with two or three *Nodosaria*, and a probable *Valvulina*. The range of the first being limited, so far as at present known, its presence is important as fixing the age of the rock; hence we thought the identification ought to rest on better authority than our own, and submitted the slice to Professor Rupert Jones, F.R.S., who, after consulting Mr. F. Chapman, F.G.S., most kindly supplied us with the following list of Foraminifera recognised: (1) *Endothyra Bowmani* (Phillips), common, some distorted; (2) *Endothyra ammonoides* (Brady), vertical section; (3) *Nodosinella* ?sp.; (4) ? *Valvulina palæotrochus* (Ehrenb.); (5) ?*Lagena lævis* (Montagu); (6) *Nodosaria radicula* (Linné), long variety; compare the *Nodosaria* of the Magnesian Limestone; (7) *Marginula*, ?sp. stout form; (8) *Vaginula*, ?sp., near *V. legumen* (Lin.)

The most numerous appear to be spherical, or rather egg-shaped, commonly about 0.25 mm. in diameter. There are two forms, one with a rather thin shell, the other thicker, composed of minute granules, and somewhat dark-coloured, probably calcite mixed with a little sand. They are not unlike *Orbulina* and *Saccamina*, but are too small for both, and not quite pyriform enough in shape for the latter. If we could detect traces of a neck we should suggest *Lagena*.[2] Those with a thinner test might possibly be ostracods. Fragments of crinoids and mollusca may also be present, but the mineral change makes identification difficult. If, as stated by Brady (*loc. cit.* p. 92), the genus *Endothyra* does not occur before the Carboniferous period, and was most abundant at that time, this limestone may be assigned to it.

17. ROCK *in situ*. Two miles north of Cape Matiusela, Waigats.

A very compact dark grey limestone, weathering to a lighter tint, with brecciated aspect.

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[1] Carb. and Perm. Foram. (Palæontogr. Soc.), Plates iv.-vi., x., xii., and corresponding text.

[2] Professor Rupert Jones accepts these as foraminiferal, but does not himself feel certain as to their identification, remarking that "such circular bodies are sometimes initial chambers of either Globigerina, Planorbulina, or even Textularia, with none of which, however, these quite correspond."

A slice was taken, cutting portions of different tints, and in it the lighter was seen to be a mosaic of clear granules of calcite, probably a little dolomitised, while the darker was crowded with brown spots, obscure fragments of organisms, the globular bodies mentioned above (but in this case more uniformly spherical), *Endothyra* and other Foraminifera.

Professor Rupert Jones, F.R.S., to whom we submitted this slide, confirms our identification of *Endothyra*, and favours us with the following list of its Foraminifera:—(1) *E. Bowmani*, Phillips (Carbonif.); (2) *Ammodiscus incertus*, D'Orbigny (Permian); (3) *A. Robersoni*, Brady (Carbonif.); (4) ? *Cristellaria*, the initial portion of a large ensiform species; (5) Numerous globular bodies, as before—foraminiferal.

There are a few longitudinal sections of small tubular organisms, some simply curved, one sharply and irregularly. In this rock mineral change seems to have gone further than in the last, and the significance of the brecciated structure is doubtful.

18. Rock *in situ*. Jackson Island, Dolga Bay, Waigats.

A rather dark and dolomitic limestone, not unlike some members of the Carboniferous system in England.

19. Rock *in situ*. Jackson Island, Dolga Bay, Waigats.

A compact dark grey limestone, with rough fracture, and showing doubtful traces of organic remains.

20. Rock *in situ*. East side of Dolga Bay, Waigats.

A dull, greenish-grey, rudely cleaved rock, showing on the cleavage faces a faint puckering crossing the axes of the elongated particles at an angle of about 70°. One or two veins of calcite traverse the specimen parallel with the cleavage. A slice shows the veins to consist of coarsely crystalline calcite, spotted irregularly with small, clear, rather rounded, grains of quartz, a few seemingly approaching to a crystalline outline, and occasional irregular patches or nests of a pale olive-green mineral, barely pleochroic, and with dull polarisation tints,—a kind of chlorite. The main mass of the rock is darkish and speckled in aspect, with a number of clearer patches, irregular in form, but rather elongated. The matrix, on applying a higher power, is seen to be a minutely granular mixture of flakes of this chlorite, iron oxide, granules of epidote (?), and a clear mineral (quartz or secondary felspar), and various microliths; rutile probably being one, and others not impossibly impure sphene or pseudo-brookite. The above-named patches consist of the chloritic and water-clear minerals to the almost entire exclusion of the dark grains. They occasionally approach to a rectangular outline, and lie with their longer axes rudely parallel.

It is extremely difficult to diagnose the true character of this rock, for it evidently has undergone a large amount of micro-mineralogical change, the principal agent probably being water. Possibly it may have been originally some form of magma basalt, approaching the intermediate group.

21. Rock *in situ*. West side of Dolga Bay, Waigats.

A grey subcrystalline limestone, with numerous veins and fissures more or less completely filled with calcite and dolomite. A slice shows it to be not very pure, slightly dolomitic, with no certain traces of organisms, but containing one or two granules of a silicate.

22. Rock *in situ*. West point of Dolga Bay, Waigats.

A dark grey dolomitic limestone, with numerous veins of dolomite, and some fragments of brachiopod (?) shells replaced by the same mineral.

23. Rock *in situ*. West point of Dolga Bay, Waigats.

A darkish rather rubbly limestone, with traces of ill-preserved organisms. In a thin section it looks as if pieces of a fragmental, fine-grained, and perhaps dolomitic limestone were cemented by coarser calcite. The angular grains of the former are themselves cemented by a dark brown material. There are two fragments of obscure organisms, one an irregular fasciculus of closely set, rather wavy, occasionally branching tubes, the other probably similar, but somewhat more regularly arranged. They are not well enough preserved for precise identification, but possibly may be calcareous algæ.

24. Rock *in situ*. Islet north of Laura Island, Dolga Bay, Waigats.

The rock is distinctly though roughly cleaved, with a foliated aspect. The cleavage surface shows a pale greenish-grey matrix, with minute metallic specks and dull light-coloured spots, varying in shape from streaks to long ovals, sometimes with a greenish speckling. Maximum length about 17 mm., breadth about 5 mm., but the majority are half these dimensions. A slice parallel to the cleavage surface shows the matrix to consist of flakes of a green chlorite, fairly pleochroic, with dull polarisation tints, grains and plates of iron oxide, probably hæmatite (specular variety), and a water-clear mineral, with a few prisms of another, presently to be noticed; also sundry microliths, many of them small rutiles, one or two zircons and yellowish granules, either epidote or a mineral allied to sphene. The structure is suggestive of foliation. In some of the patches much decomposed fragments of felspar, with very irregular boundaries, may be distinctly recognised; others partly (some wholly) consist of a pale-coloured prismatic mineral, and some flakes of the chlorite set in another mineral, varying from water-clear to dusty, probably felspar, with occasionally a little calcite. These prisms are of a clear, very pale greenish-yellow tint, with parallel sides and rather imperfectly developed ends. They are about six times as long as broad, and are generally broken across two or three times, being sometimes bent or separated at a fracture, and containing occasional enclosures (? cavities). Their longer axes tend to be parallel; polarisation tints are rather variable, sometimes fairly high; extinction sometimes straight, but occasionally oblique. Hence they probably are epidote.

We suggest that this may have been a rather porphyritic igneous rock of intermediate character, modified by crushing and subsequent mineral change.

25. Rock *in situ.* West side of Dolga Bay, Waigats.

A compact dark grey dolomitic limestone, traversed by numerous veins of carbonate and studded with white specks, which may indicate crystals of the same. Effervesces slightly in places with hydrochloric acid.

Under the microscope it is similar to No. 22, containing a few grains of quartz or a silicate, but is slightly finer in grain. It is traversed by a few thin veins of clearer crystals, both calcite and dolomite, and shows one or two more coarsely crystalline spots, which may indicate the former presence of fragments of organisms.

26. Rock *in situ.* From ridge north side of Dolga Bay, Waigats; strata nearly vertical.

A dark bluish-grey finely crystalline dolomitic limestone, traversed by numerous thin veins, probably of dolomite.

27. Rock *in situ.* Islet north of Laura Island, Dolga Bay, Waigats.

A vein specimen, consisting on one side of milky-white calcite, presenting cleavage surfaces stained brown with iron oxide, and on the other of quartz, seemingly moulded upon the calcite.

28. **Rock** *in situ.* From ridge 200 feet high, north-east side of Dolga Bay, Waigats. Strata vertical, strike NW.–SE.

A blue-grey calcareous shale, with a wavy lamination, rather distinct on a weathered surface, which is also traversed by a rude cleavage, the angle between the two structures being about 40°. A vein of calcite runs longitudinally through the specimen, and a muddy calcareous incrustation covers one side.

29. **Rock** *in situ.* North-east side of Dolga Bay, Waigats. Strata almost vertical, strike NW.–SE., making hog's-back to walk along.

A fairly well-cleaved grey limestone, traversed by numerous fine veins of calcite.

The general structure of most of the above-named limestones may be compared with that of sundry dolomites from the Italian Tyrol (Triassic), with certain specimens collected by one of us from the Mesozoic limestones in other parts of the Alps, and with dolomitic limestones (Palæozoic) in Britain. The absence of the bright polarisation tints usually indicative of dolomites is probably due to the majority of the grains being darkened by slight impurities. The same thing may be noticed in several of the specimens just named, while the crystalline dolomites from the Upper Schists of the Alps are much more brilliant.

30, 31, 32, 33. **Rocks** *in situ.* At the head of Beluga Bay, Gooseland, Novaya Zemlya.

A series of grey felspathic grits of slightly variable texture, with some bands of black shale. A slice from No. 31 shows the grit to consist of very angular, sometimes elongated, fragments of felspar, more or less decomposed, but among it plagioclase is recognisable; biotite also rather abundant, and in various stages of alteration, some flakes almost opaque, others green or bleaching, and quartz in like abundance. There are also some small rutiles, ferrite, a granular yellowish mineral (? epidote), and other unimportant secondary products. The fragments in one part of the slide average about 0.25 mm. in diameter, but in another layer are distinctly smaller. The grit has probably been mainly derived from a holocrystalline rock like a mica-diorite or syenite, more or less quartziferous.

Some fragments heated in the Bunsen flame lost their dark colour, at the same time acquiring a reddish tint. The rock must therefore be coloured to some extent by iron as well as by carbonaceous matter.

34. SLATE *in situ.* Nameless Bay, Novaya Zemlya.

A grey slate, with bands of lighter tint; many of them very thin. The cleavage is fairly good, and crosses the bedding at an angle of about 45°.

35. ROCK *in situ.* Gubina Bay, Matyushin Shar, Novaya Zemlya.

A dark grey limestone, showing doubtful traces of organic remains, with its joint-surfaces covered by a filmy white deposit of carbonate of lime. A fragment of the rock heated in the Bunsen flame was bleached to a pure white, showing that the dark colour is wholly due to carbonaceous matter.

36. ROCK *in situ.* Gubina Bay, Matyushin Shar, Novaya Zemlya.

A rather granular limestone, varying from white to light grey in colour, presenting on a weathered surface a somewhat brecciated aspect. A slice shows that the rock almost certainly contains fragments of organisms, but subsequent mineral changes, probably dolomitisation, have made identification impossible. Small more or less clustered granules of quartz traverse the slide in an interrupted, perhaps slightly bent, streak; one or two others of smaller size may be detected elsewhere. Often these granules seem to be not quite in contact, and their irregular outline suggests that, if fragmental in origin, they have been subsequently enlarged.[1]

37. ROCK *in situ.* Valley, head of Gubina Bay, Matyushin Shar, Novaya Zemlya.

A grey limestone, with numerous black specks and rough weathered surfaces. A slice shows it to be composed of granules, varying about 0.076 mm. in diameter, fairly regular in shape, some pretty clear, some dirty-looking. There are only obscure traces of organisms, but they probably have been abundant, though not large. Some dark brown specks are very likely bituminous matter. The structure, aspect, and occasional brighter tints, with crossed nicols, suggest that the limestone is dolomitic. It is traversed by one or two veins of the same mineral in a clearer state.

38. From a remarkable coloured section of shale in cliff at east entrance of Beluga Bay, Lütke Land.

A rather brittle baked shale with slight indications of lamination, brick-red on divisional surfaces, on which are often scattered deep red spots, and pinkish white or pale light red on broken edges. There can be little doubt the baking has been effected by the intrusion of a dyke or small mass of igneous rock.

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[1] See Wethered, *Quart. Journ. Geol. Soc.*, vol. xlviii. p. 377, and vol. xlix. p. 236; but in the above-described granules we do not find definite crystal outlines.

39. **Rock** *in situ.* West side of Seal Harbour, Beluga Bay, Lütke Land.

A quartz vein, showing some crystals on one surface and in hollows, traversing a rather fine-grained quartz-felspar grit of a grey colour, presenting a slight resemblance to some of the Harlech grits.

40. **Glaciated rocks** *in situ.* East side of Freddy Straits, Beluga Bay, Lütke Land.

A somewhat crushed greenstone, probably a diabase.

41. **Rock** *in situ.* West side of Seal Harbour, Beluga Bay, Lütke Land.

A fine-grit with much white mica, and with a curious flattish convex jointing. Possibly slightly affected by contact metamorphism.

42. **Rock** *in situ.* West side of Seal Harbour, Beluga Bay, Lütke Land.

A slab of fine-grained rather dark grey grit of palæozoic aspect, covered on one side with peculiar markings not easy to explain. A number of very irregular rounded, flat-topped elevations are set closely together, all of the same height, but varying in diameter from 3 to 15 mm. They tend to be elongated in the same direction, and towards one corner become smaller both in height and diameter. One, however, among them has more the character of a ridge branching at one end. It is of the same height as the others, but its length lies in a different direction.

The general appearance of the structure suggests that it may possibly have been produced by the burrowing of worms in semi-fluid mud, the numerous castings having more or less run together. The markings at least present some resemblance to the figure of the castings of *Scolithus* in Sir W. Dawson's paper,[1] if we allow for the material being coarser and the castings fewer in that case. Mr. E. T. Newton, F.R.S., who has kindly examined this specimen for us, doubts, however, whether these lumpy elevations can be of organic origin. He suggests that they may possibly be distributed ripple-marks, perhaps with trails across, or may even be some form of concretion. The reverse side, he observes, shows some impressions which seem to be of organic origin, and may possibly represent traces of decayed wood. We fear that none of the explanations suggested above will command universal assent.

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[1] *Quart. Jour. Geol. Soc.*, vol. xlvi. (1890), p. 603, fig. 7.

43. ROCK *in situ.* West side of Beluga Bay, Lütke Land.

A fine to medium grained holocrystalline greenstone (diabase?), rather decomposed, with some pyrites; the felspar, which is stained a pale greenish colour, predominating over the pyroxenic constituent. Slight slickensides on an irregular joint face.

44. ROCK *in situ.* West side of Beluga Bay, Lütke Bay.

A vein specimen, the wall rock being a greenstone apparently silicified and traversed by minute veins of asbestos. The vein itself consists of columnar chalcedonic silica separated by films of asbestos. The columns of silica are rounded and from 1 to 5 mm. in diameter, varying in colour from white to dull greenish-grey. Some of them show well-marked lighter bands, traversing more than one column continuously and obliquely. Hence they are probably pseudomorphs; and since on many of them oblique transverse striations may be clearly seen, which are very similar to the striations, due to lamellar twinning, in columnar aragonite, they may possibly be pseudomorphous after that mineral. The columns are all bent more or less in the same direction.

45. ROCK *in situ.* Silver Bay, West Coast, Lütke Land.

A slate-coloured mudstone, seemingly with an obscure cleavage, but not fissile.

46. ROCK *in situ.* Summit of hill 1400 feet, Ziwolka Fjord, Lütke Land.

A clay slate with a fairly good cleavage and of a dull dark colour with a slight purple tinge, but weathering greyer. It resembles generally some of the inferior samples of Llanberis slate.

ERRATICS FROM CAPE MATIUSHA, EAST SIDE OF WAIGATS.

47. A biotite granite with two felspars (one white, the other yellowish-pink, and sometimes porphyritic), but not rich in quartz.

48. A fine-grained brownish calcareous felspathic grit.

49. A dark grey limestone, with some ill-preserved brachiopods, and full of fragments of organisms. Thinking we recognised a *Productus*, we submitted this specimen to Mr. E. T. Newton, F.R.S., who writes: "It contains several examples of the *scabriculus* and *subaculeatus* type, as well as two forms of *Rhynchonella* and an *Orthis*. It seems highly probable that the rock is of Carboniferous age, but as many similar forms occur in the Devonian, it possibly may prove to be of the latter age."

50. A speckled dark grey grit, with many angular quartz and felspar grains, measuring from 1 to 3 mm. in greatest diameter.

51. Fragment of the guard of a rather large belemnite, nearly 3 cm. in diameter, probably Jurassic.

52, 53. A biotite granite, with two felspars, one yellowish-white, the other light red.

54. A dark grey fine-grained felspathic grit, smoothed and striated by ice action on one side.

55. Lignite, most probably not earlier than Tertiary age.

56. A lump of grey limestone, with a number of very irregular, dark, branching ridges and prominences weathered out on the surface. They are easily scratched by the knife, effervesce slightly with acid, and sometimes exhibit small projecting rhombohedra of dolomite. Possibly they represent parts of the limestone which have been more completely dolomitised than the rest, perhaps along accidental fractures.

57. Pachtussow Island, 74° 24′ N. Erratic.

A rounded lump of very vesicular basalt, much water-worn, floating in fresh water with about one-tenth of its volume above the surface.

NOTES ON THE FOSSILS COLLECTED BY COLONEL H. W. FEILDEN IN NOVAYA ZEMLYA, 1897. BY E. T. NEWTON, F.R.S., F.G.S.

There are two series of these fossils, collected from two far distant localities. One series is from Cape Greben, at the south end of the island of Waigats, and they are apparently all from one horizon, the matrix being a dark grey limestone, which in some cases is almost black when polished. The second series is from Pachtussow Island, Lütke Land, 74° 24′ N. lat., which is on the east side of the north island of Novaya Zemlya, in the Kara Sea; and these also are preserved in an almost black limestone.

I.—FOSSILS FROM CAPE GREBEN.

Professor Lindström,[1] in his paper on "Silurian Corals from Northern Russia and Siberia," described two forms from Cape Greben, namely, *Favosites Forbesii* and *Syringopora fenestrata;* with these he also recognised *Prœtus conspersus*, *Lichas*, many examples of *Leperditia*, *Atrypa didyma*, and other fossils. These specimens, which had been obtained by Professor Nordenskiold, he thought to be of Upper Silurian age, but two or three other forms, which it seems came from a different bed, appeared to him possibly to represent Devonian strata. Professor Nordenskiold had noted that the beds at Cape Greben were nearly vertical, and were separable into five distinct series, which he distinguished by the letters A—E. The Silurian fossils were from Bed A; the possibly Devonian forms from Bed D. The Leperditias from Cape Greben were submitted to M. Fr. Schmidt, who, in his *Nachtrag* to the Russian Silurian Leperditias,[1] described three new species, all of large size. With the exception of *Lichas*, all the forms mentioned by Professor Lindström as of Silurian age, as well as the three species of *Leperditia*, are represented in Colonel Feilden's collection, together with some additional genera, and the presence of Upper Silurian rocks at Cape Greben thus receives confirmation.[2]

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[1] *Bihang till K. svenska Vet. Akad. Handl.*, Band 6, No. 18, p. 6, 1882.

COELENTERATA.

Favosites Forbesii, E. & H.

There are ten specimens from Cape Greben of a Favosite coral, which are doubtless the same form as those referred by Professor Lindström to the above species. These are all pieces of hemispherical masses, varying from 2 inches to 4½ inches in diameter. The corallites are polygonal, and the largest are 2 mm. in diameter; but there is not so great a variation in size as is usually characteristic of this species. The mural pores are said by Professor Lindström to be in two longitudinal rows, and in the present specimens the double rows can sometimes be traced; but in other cases there seems to be only one row.

Syringopora fenestrata, Lindst.

This species was established by Professor Lindström for specimens from Cape Greben, and there are several fragments of what I have no doubt is the same form in the present series; but the septa are so well developed that one has misgivings as to whether it should be placed in this genus. The corallites were seen by Professor Lindström to reach a length of 16 cm.; the present specimens, which are broken, only reach 4 cm. Each corallite is nearly straight, about 2 mm. in diameter, and separated about the same distance from the adjoining corallites, which are united by transverse bars, placed, with some regularity, at intervals of about 5 or 6 mm., so that on the broken face of the rock a very regular network is formed, which has given this coral its specific name. The tabulæ are funnel-shaped, and are seen best in longitudinal sections; but in transverse sections they are shown as more or less irregular concentric circles, filling the middle part of the corallite. In all the above points our specimens agree with the original description. According to Professor Lindström a series of short, straight, equal-sized septa surround the funnels, and at first sight the present specimens seemed the same; but when transparent sections were examined, it was noticed that some of the septa were twice as long as others, and extended far towards the centre. The large septa are irregularly placed; in some corallites they are not seen, and in others there may be one or more. Another point not mentioned by Professor Lindström is that many of the corallites seem to show punctate or granulate costæ. I am inclined, however, to think that these longitudinal rows of granules are not really external, but are due in some way to the denticulate inner edges of the septa.

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[1] *Mem. Acad. Imp. Sci. St. Petersburg*, Ser. vii. vol. 31, No. 5, 1883, pp. 25 and 85.

[2] Since these notes have been in type, I have seen the paper by MM. Th. Tscherneyschew and N. Jakowlaw on *Die Kalkstein Fauna des Cap Grebeni auf der Waigatsch Insel und des Flusses Nechwatowa auf Nowaja-Semlya* (*Verhaudl. Russ. Kais. Mineral. Gesellsch.*, St. Petersb., Ser. 2, vol. xxxvi. p. 55, 1899). These writers are inclined to ascribe a Lower Devonian age to the lower beds at Cape Greben.

HYDROZOA.

Stromatoporoid.

A portion of a dome-shaped Stromatoporoid has been cut through in hopes of showing its minute structure, and a thin section has been prepared, but unfortunately it is so much altered by crystallisation that its structure is almost obliterated. In some parts a number of thin plates or tabulæ are seen; these are very close together, and arranged more or less parallel to the convex outer surface: they are not continuous, but broken into short lengths and set, as it were, in piles, as if they had been tabulæ close set in tubes (resembling the corallites of *Favosites*), but the tubes are wanting, and the tabulæ in adjacent piles sometimes join. I am unable to suggest any genus to which this could be referred.

CRUSTACEA.

ENTOMOSTRACA.

Leperditia Nordenskioldi, Schmidt.

A single right valve referable to this species measures 14 mm. from front to back; the hinge is straight, angular at both ends, and nearly as long as the valve.

The greatest height from the oral margin to the hinge is at the posterior third of the valve, and measures 8.5 mm. Anteriorly, the shell is reduced a little in height. Both anteriorly and posteriorly the valve is deeply grooved, but the groove dies out on the oral margin. The valve is much inflated towards the oral margin. Below and behind the prominent eye-spot the valve is ornamented with small but distinct granules.

Leperditia Waigatschensis, Schmidt.

A perfect left valve of this species is 10 mm. long and 7 high; it is nearly semicircular in outline, with a straight, angulated hinge. This species is even more inflated at the oral margin than the one last described, but the anterior and posterior grooves are continued around the oral region. Several portions of valves, apparently belonging to this species, are to be seen on two or three pieces of the limestone.

Leperditia Lindströmi, var. *mutica*, Schmidt.

A portion of a large *Leperditia*, which must have been twice the length of *L. Nordenskioldi*, is referred to this variety. No perfect valve of this form has yet been found, all the examples seen by M. Schmidt being broken, and from this fact it may be inferred that the valves were very fragile.

TRILOBITA.

Proetus.

On one of the pieces of limestone is the tail of a small Trilobite, measuring 5 mm. in width and 3 or 4 in length. The median lobe is distinctly segmented, the pleuræ are well marked, and there is a distinct margin. This tail may belong to *Proetus conspersus*, the species mentioned by Professor Lindström, but the evidence is insufficient for definite determination; it is only one-third the size of Angelin's figure of that species, and it does not show the granulation of the surface, which is the specific character.

BRACHIOPODA.

Meristina (*Atrypa*) *didyma*, Dalman.

Numerous specimens of a small Brachiopod, which appears to be the form alluded to by Professor Lindström as *Atrypa didyma*, are among the fossils from Cape Greben. There is much variation in the form of these specimens, some being elongated and others as wide as they are long; but on the whole they agree fairly well with the figures of the species given by Davidson (Pal. Soc. vol. iii. pl. xii.), with the exception that they show no groove on the dorsal valve, and that on the ventral valve, in nearly all the specimens, causes a fold on the front margin not seen in any of Davidson's figures, and he says they have no fold. These differences made me doubt if Colonel Feilden's specimens could be the same species as those seen by Professor Lindström, but on comparing them with examples of *A. didyma* from Gotland, I find that four out of five specimens have a very distinct fold on the front. The Cape Greben specimens are for the most part internal casts, but some of them show strong radial striations as well as distinct lines of growth, producing a well-marked cancellation of the surface, a character present in the Gotland examples. One shell shows that the beak was imperforate.

Spirifera crispa ?, His.

Several specimens of a small oval *Spirifera*, having the form of Davidson's figure 14 on plate x., are referred to this species; they have a large median ridge and two or three lateral ribs which seem to have been crossed by lines running parallel with the margin, but none of the specimens are sufficiently perfect to allow one to speak very positively.

Orthis rustica, Sow. var.

One piece of limestone which has been broken open contains numerous examples of an *Orthis* which I think must be regarded as a fine variety of this species, resembling as it does the variety *Walsallensis* of Davidson. The largest example is about three-fourths of an inch wide; the hinge-line is nearly straight and a little shorter than the widest part of the shell; the dorsal valve is moderately convex; the ventral valve is almost flat; the beak slightly projecting. The largest specimens have the valves ornamented with from fifty to sixty fine radiating ribs, many of which pass to the beak, but others stop at about two-thirds of this distance; some of the ribs bifurcate towards the margin. The spaces between the ribs are crossed by fine lines. In outline these shells resemble most nearly Davidson's figure 14 of plate xxxiv., but the ribs are more numerous, and in this particular the shell approaches var. *Walsallensis*, figure 20. There is much resemblance between the Waigats *Orthis* and *O. basalis* from Gotland, but the latter has a greater length from the beak to the front, and consequently a very different outline.

GASTEROPODA.

Murchisonia ?

There are three or four portions of a shell which may belong to this genus, but they are little more than internal casts. The most perfect has seven whorls in a length of 21 mm., and the diameter of the base is 11 mm.; whilst the last whorl is not more than 4 mm. high. This shell has some resemblance to *Holopella concinna* of Sowerby, but the whorls are larger in proportion to their height than in that species. The shell more nearly resembles the *Murchisonia compressa* of Lindström,[1] but even that has rather higher whorls. A single whorl, and seemingly a last one, of a large specimen from Cape Greben, has a diameter of 16 mm. and a height of 6 mm.; it has a ridge along the outer part, which may indicate the position of a siphonal notch; and it is this and its resemblance to Lindström's figure that induces me to refer this gasteropod provisionally to *Murchisonia*.

Loxonema, sp., cf. *strangulata*, Lindst.

A portion of the internal cast of a Gasteropod, showing parts of three whorls, much drawn out, has a close resemblance, so far as preserved, to the *Loxonema strangulata* of Lindström.[2]

CEPHALOPODA.

Orthoceras, sp.

A portion of an *Orthoceras*, about an inch in diameter, has six chambers in a little less than an inch. The siphuncle is excentric, the edges of the septa are slightly undulated, and the exterior seems to have been smooth, or at any rate not to have been ribbed or strongly ornamented.

II.—FOSSILS FROM PACHTUSSOW ISLAND.

There are six pieces of limestone from Pachtussow Island, which are to a large extent composed of corals referable to the genera *Favosites*, *Pachypora*, *Syringopora*, and *Alveolites*. The matrix is almost black and the corals are white; consequently on both the weathered and polished surfaces the fossils show very distinctly; but when examined with a lens, the crystallisation is found seriously to obscure the structure, and this is still worse when thin slices are examined with the microscope.

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[1] Sil. Gast. Gotland, 1884, Pl. xii. fig. 17.

[2] Loc. cit., Pl. xv., fig. 10.

Pachypora cristata ?, Blum.

Three of the specimens are very largely made up of a branching coral, the stems of which are about one-fourth of an inch in diameter. The corallites are nearly circular, and they are set at right angles to the surface, but the manner of their termination in the interior of the stem cannot be seen; their diameter is less than one-fortieth of an inch (0.5 mm.). The walls are thick, and their double condition can in some cases be very clearly seen. The dark rock reminds one of some of our own Devonian and Carboniferous limestone, and leads to a comparison with *Pachypora reticulata;* but the branches of the present form are only half the width, and the apertures of the corallites only half the diameter of that species, as described by Edwards and Haime. Some specimens, however, that have been referred to *P. reticulata* have more slender branches and smaller corallites. The Silurian species *P. cristata* is another closely allied form, which seems to agree even more closely with the Novaya Zemlya specimens, and provisionally it is referred to that species.

Favosites, cf. *Hisingeri*, M'Edw.

A portion of a hemispherical *Favosites*, which must have been three or four inches in diameter, is built up of small polygonal corallites only about one-thirtieth of an inch in diameter. A thin section shows the mural pores in one or two rows; the walls are irregular in thickness, being roughened by the septal spines, which, though short, are very distinctly seen; the tabulæ are thin, numerous, and, for the most part, horizontal. This coral approaches very near to *Favosites Hisingeri*, but the section of that species with which I have been able to compare it does not show the strong denticulations, and has the walls uniform in thickness. Although these differences may be only individual variations, they prevent a definite reference of the present specimen to that species.

Favosites ? or *Nodulipora ?*

One or two portions of rounded masses of a coral like *Favosites*, but with the apertures of the corallites of very irregular form, reminds one of the *Nodulipora* of Lindström, but the specimens are too imperfect for determination.

Syringopora, sp.

There are two examples of a *Syringopora*, the genus being recognisable by the sections of the funnel-shaped tabulæ. Their habit of growth seems to be in short rounded masses resembling *Syringopora bifurcata*, and, as in that species, the corallites have a diameter of about 2 mm. The available evidence, however, does not suffice for specific determination in a genus where the species are so much alike.

Alveolites, sp.

One piece of limestone contains a number of broad and thin expansions of a coral which can only be referred to *Alveolites*. One of these is nearly 4 inches across, but at the thickest part visible only measures 5 mm. These expansions do not appear to have been attached by any large part of their surface, but to have been more or less free and of an irregular saucer-like form. The calices of the corallites have the usual semicircular form, and in one place may be seen to open on a convex surface, while in another they are shown on a concave surface. A section of the largest expansion, taken at its thickest part, shows the corallites opening on the concave side only. The calices are from 0.5 to 0.3 mm. wide; the tabulæ may be seen here and there crossing the tubes at right angles. The convex side of the corallum seems to be vesicular, and from this the corallites curve upwards towards the concave surface, becoming more distinct as they approach this surface, on which they open somewhat obliquely. This appears to be an undescribed species, and if so, might be named after its discoverer, *Alveolites Feildeni*.

It is unfortunate that none of the specimens from Pachtussow Island can be determined with sufficient exactitude to give a definite idea of their geological horizon. On the whole, they seem more likely to be of Silurian than of Devonian age; but seeing that beds of the latter period are supposed to be present in Novaya Zemlya, it is possible these Pachtussow specimens may be of that age.

NOTES ON FOSSILS OF CARBONIFEROUS AGE. COLLECTED BY MR. WM. S. BRUCE, AT CAPE CHERNI, NOVAYA ZEMLYA, IN 1898.

By E. T. NEWTON, F.R.S.

Mr. W. S. Bruce was cruising during the summer of 1898[1] with Mr. Andrew Coats, in his yacht "Blencathra," around the coasts of Kolguev, Waigats, and Novaya Zemlya; and although more especially devoted to making observations on recent natural history, lost no opportunity of landing and securing such geological specimens as it was possible for him to obtain. Having on one occasion landed at Cape Cherni, a little to the south of Kostin Shar, he was much impressed with the fossiliferous character of the limestone rocks, and collected a goodly number of specimens, most of which contained portions of large Productus-like shells; there was likewise a black concretionary mass, much broken and having a carbonaceous appearance, but showing no woody structure. Besides these, he brought away with him a block of the limestone much shattered by frost, but evidently containing many fossils.

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[1] Scottish Geographical Society, vol. xv. p. 113, 1899.

Mr. Bruce, who, as a member of the Jackson-Harmsworth Polar Expedition, was acquainted with my work among the fossils collected in Franz Josef Land, very kindly showed me these specimens from Cape Cherni, thinking they might throw light upon my earlier work; and when he knew that I had already examined the series brought home by Colonel Feilden from Novaya Zemlya, he at once fell in with that gentleman's suggestion that some notes upon the Cape Cherni fossils should find a place with those on Colonel Feilden's fossils in the present work, and thus add the latest information, and a by no means unimportant contribution, to the geology of Novaya Zemlya.

The Cape Cherni specimens being left in my hands, I proceeded to break up the block of limestone, and the forms exposed, although for the most part fragmentary, showed an unmistakably carboniferous aspect. Brachiopods are undoubtedly the most abundant forms, including several genera besides *Productus;* one or two slabs are almost wholly made up of crinoid ossicles, and there are two or three forms of corals. Gasteropoda are represented by some few indistinct remains.

BRACHIOPODA.

Productus giganteus (?) seems to be indicated by several fragments of a large form of this genus, having somewhat coarse sculpture; but none of the specimens are sufficiently perfect to show the outward form.

Productus semireticulatus, Martin. One specimen, about one and a quarter inch wide, is referred to this species with some degree of certainty; and a second, of twice the diameter, may be the same; but the strong wrinkles or ribs on the wings resemble those found in *Productus cora.*

Productus fimbriatus, Sow. Several examples of convex valves and some flattened ones show strong concentric ridges, with indications of spines; and as they have no median fold, but are uniformly convex, they are referred to this species.

Productus spinulosus, Sow. Two examples of small but very convex valves agree, so far as can be seen, with this species. One of them has the tubercles regularly arranged in radiating lines, but alternating in contiguous rows.

Chonetes papilionacea (?), Phil. Two flat and almost semicircular valves two inches across, with fine, irregularly radiating, thread-like lines, crossed by delicate lines of growth, closely resemble Davidson's figure of this genus and species, and are almost certainly to be referred to this form, but the characteristic spines of the hinge margin are not to be seen.

Spirifera (three or more species). A single fragment of a valve, with deep ventral groove and angular lateral ridges crossed by strong lines of growth, is most likely to be *Spirifera laminosa*, M'Coy. Two specimens, marked by broad but indistinct longitudinal ribs, which extend into the median sulcus of the ventral valve, represent *Spirifera bisulcatus*, *S. supramosquensis*, or some closely allied form. One or two fragments of valves, with only three large ribs on each side of the middle line, and these strongly punctate, remind one of *S. insculpta*, but cannot be referred to that species.

Reticularia (*Spirifera*) *lineata*, Martin. There is one small but perfect example of this species. It is about one-third of an inch wide, has the two valves equally convex and marked by concentric bands crossed by fine radiating lines.

Orthis Michelini, L'Eveillé. I have only met with one example of this species, but it is in a very perfect state of preservation; it has all the characters of our British specimens, and in outline agrees best with Davidson's pl. 30, fig. 6. It is 19 millimetres wide and 17 long.

Streptorhynchus crenistria (?), Phil. Some few fragments of a brachiopod, with regularly radiating ribs and wide interspaces crossed by fine lines, may be examples of this species.

ECHINODERMATA.

Three small slabs of limestone are very largely made up of crinoid ossicles, which are round, and with a circular central aperture. Portions of crinoid stems, composed of similar rounded ossicles, are to be seen on several of the specimens containing brachiopods. Some of these stems have a smooth exterior, while others have each of the ossicles rounded externally so as to form strong transverse ridges; they may represent two such forms as *Poteriocrinus* and *Actinocrinus*.

CORALS.

There are three examples of a species of turbinate coral, each much obscured by matrix, which measure about 2½ inches in length and 1½ inch in diameter at the widest end, tapering much to the smaller or lower extremity. Externally these corals are irregularly rugose, marked by wrinkles of growth which are crossed by fine vertical lines or costæ. Where broken across, they show a vesicular external layer, from which septa project some distance towards the centre, but leave a large space in the middle. These specimens are without doubt referable to the genus *Campophyllum*, and most nearly resemble *C.* (*Zaphrentis*) *cylindrica*, but their exterior is more irregular and tapering than is usually the case in that species.

Two other kinds of corals occur in this limestone, which are at present undetermined; externally they are very similar, being about three-fourths of an inch in diameter, cylindrical, bent, with concentric growth wrinkles and numerous costæ. One of these may be a *Cyathophyllum*, there being regular but fine septa, which apparently pass to the middle of the corallum. The second form is very different in transverse section; it shows very fine, indistinct, and irregular septa—if indeed they can be called septa, for they have more the appearance of radiating and branching rods—ending in thickened pali, which form an inner wall. In vertical section the same irregular rod-like septa are seen distinctly marked off from the central third of the corallum, which is occupied by horizontal tabulæ.

The general aspect of this collection of fossils from Cape Cherni undoubtedly points to their being of Carboniferous Limestone age; and there seems on the whole a closer resemblance to the forms with which we are familiar in England and Western Europe, rather than to those which have been figured from Russia and the Urals. It may, however, be expected that when a larger series of these Cape Cherni fossils has been examined, their closest relationship will be found to be with the Carboniferous rocks of North-Eastern Russia.

REPORT ON PLEISTOCENE FORAMINIFERA FROM NOVAYA ZEMLYA.

BY MR. JOSEPH WRIGHT, F.G.S.

The Pleistocene clays from Novaya Zemlya and vicinity which were sent to me by Colonel H. W. Feilden, F.G.S., for microscopical examination, consisted of twenty-six small samples; twelve of these were from various parts of the great terraces of Cape Matinsela, and have been treated as from one locality. The weight of the clay received was only 3 lb. 2 oz. Troy, averaging about 2½ oz. weight from each locality. I also received four small samples of the sea-bottom, taken a short distance from land, and in proximity to places where the other clays were obtained. These were sent to me for the purpose of comparing the difference in the foraminiferal fauna of the present time to what prevailed when the clays were deposited.

Foraminifera occurred in all the Pleistocene clays; in nine of them they were very rare or rare, in one of them they were plentiful, and in the other five they were in great profusion. Sponge spicules in a somewhat fragmentary state were also found in nearly all of them, and Ostracods and spines of Echinoderms in several. The Foraminifera most abundant were *Cassidulina lævigata*, *C. crassa*, *Truncatulina refulgens*, *T. lobatula*, *Nonionina depressula*, and *Polystomella striato-punctata;* the two Cassidulinæ being usually very large in size, many of them being three diameters larger, or twenty-seven times the size in bulk, of these species as they are at present found off the British coast.

None of the Arenaceous Foraminifera occurred in the clays; whilst in the shallow-water gatherings four species were found, one of them, *Verneuilina polystropha*, being of common occurrence; and notwithstanding the frequency of *Cassidulina lævigata*, *C. crassa*, *Truncatulina refulgens*, and *T. lobatula*, the only specimens of these found in the recent gatherings were two small examples of *Cassidulina crassa.*

As the samples were small, nearly all of the clay was examined in detail, floatings being merely taken in a few cases, and with these only the very finest of the washings were treated in this way.

Nearly all of the stones which occurred in the clays were more or less rounded, and presented the appearance of having been worn by marine action; in a few cases they were smoothed and striated, as if by the action of ice.

The conditions under which these clays were deposited must have been very varied, as in some of them Foraminifera are most abundant, whilst in others they are extremely rare. When they are abundant, it may be inferred that the clays were laid down in quiet water or in sheltered bays, and not subjected to the rapid running of currents or tides; and when they are rare, it may be presumed that the reverse was the case.

1. "MUD WITH SHELLS, 50 feet elevation, west side of Dolga Bay, Waigats Island, July 2, 1897."

FORAMINIFERA.

Cassidulina lævigata, d'Orb., frequent.
C. crassa, d'Orb., frequent.
Nodosaria pauperata, d'Orb., one broken specimen.
Uvigerina angulosa, Will., one specimen.

Pullenia quinqueloba, Rss., one small specimen.
Pulvinulina Karsteni (Rss.), one small specimen.
P. punctulata (d'Orb.)?, one small specimen.
Truncatulina refulgens (Montf.), rare.
T. lobatula (W. & J.), common, specimens small.
Nonionina scapha (F. & M.), one specimen.
N. stelligera, d'Orb., one specimen.
N. depressula (W. & J.), very common, specimens small.
Polystomella striato-punctata (F. & M.), rare.
P. arctica, P. & J., rare.

Sponge spicules, frequent.

2. "Clay with Shells, from a section 50 feet above the sea in the stream that runs into Starvation Bay, northern shores of Waigats Island, July 6, 1897."

FORAMINIFERA.

Miliolina seminulum (Linn.), one specimen.
Nonionina depressula (W. & J.), three specimens.
Polystomella arctica, P. & J., one specimen.

3. "Mud with Shells, 50 feet elevation, Waigats Island, Dolga Bay, July 1897."

FORAMINIFERA.

Miliolina seminulum (Linn.), one specimen.
Nonionina depressula (W. & J.), one specimen.

4. "Clay with Shells, 100 feet elevation, Waigats Island, Dolga Bay, July 1897."

FORAMINIFERA.

Cassidulina lævigata, d'Orb., rare.
C. crassa, d'Orb., very rare.
Nodosaria pauperata, d'Orb., fragment of a large specimen.
Uvigerina canariense, d'Orb., one specimen.
Truncatulina lobatula (W. & J.), one specimen.
Nonionina depressula (W. & J.), frequent.
N. umbilicatula (Montf.), rare.
Polystromella arctica, P. & J., very rare.
P. striato-punctata (F. & M.), one specimen.

5. "Clay, 50 feet elevation, south end of Waigats Island, July 12, 1897."

Foraminifera.

Cassidulina crassa, d'Orb., one specimen.
Truncatulina refulgens (Montf.), one specimen.
T. lobatula (W. & J.), very rare.
Nonionina depressula (W. & J.), one specimen.

6. "Clay with Shells, 50 feet elevation, neighbourhood of Habarova, Yugor Straits, Russian mainland, July 17, 1897."

Foraminifera.

Cassidulina lævigata, d'Orb., one specimen.
C. crassa, d'Orb., one large specimen.
Truncatulina refulgens (Montf.), one specimen.
Polystomella striato-punctata (F. & M.), one specimen.

7. "Clay with Shells, 25 feet elevation, forming the surface soil of the tundra around Habarova, Yugor Straits, Russian mainland, July 17, 1897."

Foraminifera.

Virgulina Schreibersiana, Cz., two large specimens.
Cassidulina lævigata, d'Orb., rare.
C. crassa, d'Orb., very common.
Lagena lævis (Montg.), one specimen.
L. squamosa (Montg.), very rare.
Cristellaria crepidula (F. & M.), very rare, specimens large.
Polymorphina rotundata (Born.)?, one broken specimen.
Truncatulina lobatula (W. & J.), frequent.
Pulvinulina Karsteni (Rss.), frequent.
Nonionina depressula (W. & J.), abundant.
N. stelligera, d'Orb., very common.
Polystomella arctica, P. & J., very rare.
P. striato-punctata (F. &. M.), very common.

Ostracods, very common.
Sponge spicules, frequent.

242 specimens of *Nonionina depressula* and 67 specimens of *Polystomella*

striato-punctata were obtained from this gathering, whilst the other species numbered in all only 102.

8. "SAND AND CLAYS from various sections of the great terraces and deposits of Cape Matinsela, east side of Waigats Island. These mud-cliffs rise to a height of 150 feet maximum, in an immense deposit stretching for miles, full of erratic boulders, July 18, 1897."

FORAMINIFERA.

Miliolina seminulum (Linn.), one specimen.
Nonionina depressula (W. & J.), one specimen.

Sponge spicules, very common.

I received twelve samples of these sands and clays, taken from various parts of the deposit, eleven of which I examined; they averaged in weight little more than half an ounce Troy. The greater portion of the stones in them were more or less rounded, and had the appearance of being worn by marine action; in this respect they were very similar to the other clays which I examined, and in which Foraminifera occurred in greater numbers. Sponge spicules occurred in all of the samples.

9. "100-foot TERRACE, bordering the sea, east side of Beluga Bay, Matyushin Shar, July 31, 1897."

FORAMINIFERA.

Cassidulina lævigata, d'Orb., one specimen.
Lagena marginata (W.& B.), one specimen.
Truncatulina lobatula (W. & J.), very rare.

10. "CLAY WITH SHELLS, 500-feet Terrace, Beluga Bay, Matyushin Shar."

FORAMINIFERA.

Miliolina seminulum (Linn.), frequent.
Cassidulina lævigata, d'Orb., most abundant, specimens large.
C. crassa, d'Orb., most abundant, specimens large.
Lagena acuticosta, Rss., very rare.
L. Williamsoni (Alcock), very rare, specimens small.
L. globosa (Montg.), one specimen.
L. striato-punctata, P. & J.?, one worn specimen.

L. squamosa (Montg.), frequent, specimens large.
L. lævigata (Rss.), one specimen.
L. marginata (W. & B.), frequent, specimens large.
Nodosaria pauperata, d'Orb., very rare, fragments.
Cristellaria crepidula (F. & M.), one specimen.
Discorbina globularis (d'Orb.), frequent, specimens small.
D. Wrightii, Brady ?, rare, specimens small.
Pulvinulina Karsteni (Rss.), rare, specimens small.
P. punctulata (d'Orb.)?, common, specimens small.
Truncatulina refulgens (Montf.), most abundant.
T. lobatula (W. & J.), most abundant.
Nonionina depressula (W. & J.), most abundant.
N. umbilicatula (Montf.), frequent.
N. turgida, Will., one small specimen.
N. stelligera, d'Orb., rare.
Polystomella crispa (Linn.), one specimen.
P. striato-punctata (F. & M.), most abundant.

Ostracods, rare, specimens large.
Echinus spines, most abundant, specimens large.

Cassidulina lævigata, *C. crassa*, *Truncatulina refulgens*, *T. lobatula*, *Nonionina depressula*, and *Polystomella striato-punctata* were most abundant in the clay, and were estimated to number in all about 840 specimens, whilst the other 18 species numbered only 75. *Cassidulina lævigata* was exceptionally abundant, numbering about 300 specimens; it, as also *C. crassa*, were very large in size, being about three diameters larger than specimens occurring off the British coast.

11. "STIFF YELLOW CLAY from a Terrace exposure on the east side of Beluga Bay, Matyushin Shar, about 100 feet high, August 3, 1897."

FORAMINIFERA.

Truncatulina refulgens (Montf.), rare, specimens large.
T. lobatula (W. & J.), one large specimen.

12. "STIFF YELLOW CLAY from a Terrace exposure on the east side of Beluga Bay, Matyushin Shar, about 100 feet high, August 3, 1897."

FORAMINIFERA.

Truncatulina lobatula (W. & J.), very rare.

13. "Clay and Sand deposit from a Terrace 130 feet high, south side of Matyushin Shar, August 3, 1897."

Foraminifera.

Virgulina Schreibersiana, Cz., one specimen.
Cassidulina lævigata, d'Orb., very common.
C. crassa, d'Orb., very common.
Lagena squamosa (Montg.), one specimen.
Truncatulina refulgens (Montf.), rare.
T. lobatula (W. & J.), most abundant.
Pulvinulina Karsteni (Rss.), frequent.
Nonionina depressula (W. & J.), common.
N. turgida, Will., one small specimen.
N. scapha (F. & M.), rare.
N. stelligera, d'Orb, rare.
Polystomella subnodosa (Münst.), very rare.
P. striato-punctata (F. & M.), common.

Ostracods, one specimen.
Sponge spicules, rare.

It was intimated that about 200 specimens of *Truncatulina lobatula* occurred in this clay, whilst the other species numbered in all only 111.

14. "Shell-bed, Beluga Bay, Matyushin Shar, 3 miles inland, 300 feet mud-beds, August 4, 1897."

Foraminifera.

Miliolina seminulum (Linn.), common.
M. tenuis (Cz.), very rare.
Virgulina Schreibersiana, Cz., one specimen.
Bolivina plicata, d'Orb., common.
Cassidulina lævigata, d'Orb., very common, specimens large.
C. crassa, d'Orb., very common, specimens large.
Lagena globosa (Montg.), frequent.
L. lævis (Montg.), one specimen.
L. sulcata (W. & J.), frequent, specimens large.
L. Williamsoni (Alcock), rare, specimens large.
L. distoma (P. & J.), one specimen.

L. squamosa (Montg.), very common, specimens large.
L. lævigata (Rss.), very rare.
L. marginata (W. & B.), very common.
Nodosaria pauperata, d'Orb., one large specimen.
N. calomorpha, Rss., very rare.
Polymorphina lanceolata, Rss., rare.
Uvigerina canariense, d'Orb., very rare.
U. angulosa, Will., one specimen.
U. pygmæa, d'Orb., very rare.
Patellina corrugata, Will., one small specimen.
Globigerina bulloides, d'Orb., rare.
Discorbina globularis (d'Orb.), common.
Truncatulina refulgens (Montf.), very common, specimens large.
T. lobatula (W. & J.), very common, specimens large.
T. ungeriana (d'Orb.), one specimen.
Pulvinulina Karsteni (Rss.), very common.
Nonionina depressula (W. & J.), very common.
N. umbilicatula (Montf.), common, specimens large.
N. turgida, Will., rare, specimens small.
N. scapha (F. & M.), frequent.
N. stelligera, d'Orb., common.
Polystomella striato-punctata (F. & M.), very common.
P. arctica, P. & J., very rare.

Echinus spines, rare.

Foraminifera occurred in this clay in great profusion, many of them being large in size and in a state of fine preservation.

15. "CLAY WITH SHELLS, 250 feet elevation, Nameless Bay, west coast of Novaya Zemlya proper, August 12, 1897."

FORAMINIFERA.

Virgulina Schreibersiana, Cz., rare.
Bulimina pupoides, d'Orb., one specimen.
Cassidulina lævigata, d'Orb., very common.
C. crassa, d'Orb., most abundant.
Uvigerina angulosa, Will., very rare.
Truncatulina refulgens (Montf.), frequent.

T. lobatula (W. & J.), very common, some of the specimens small.
Pulvinulina Karsteni (Rss.), very common.
Nonionina depressula (W. & J.), most abundant.
N. scapha (F. & M.), frequent.
N. stelligera, d'Orb., frequent.
Polystomella striato-punctata (F. & M.), very common.
P. arctica, P. & J., rare.

Some of the larger stones in this clay were smoothed and striated as if by ice action. Foraminifera abundant.

1. "Dolga Bay, Waigats Island, 4½ fathoms, July 9, 1897."

Foraminifera.

Haplophragmium, sp., frequent.
Verneuilina polystropha (Rss.), frequent.
Nonionina depressula (W. & J.), one specimen.
Polystomella striato-punctata (F. & M.), rare.

Sponge spicules, frequent.

2. "Straits of Yugor, 4½ fathoms, July 17, 1897."

Foraminifera.

Miliolina subrotunda (Montg.), one small specimen.
M. seminulum (Linn.), very rare.
Polymorphina rotundata (Born.), very rare.
Pulvinulina Karsteni (Rss.), very rare,
P. punctulata (d'Orb.), frequent.
Nonionina depressula (W. & J.), abundant.
Polystomella striato-punctata (F. & M.), frequent.

Ostracods, common.
Sponge spicules, very common.

126 specimens of *Nonionina depressula* occurred in this gathering, whilst the other species numbered in all only 28.

3. "TEN MILES WEST OF BELKOFSKI NOS, 8 fathoms, July 19, 1897."

FORAMINIFERA.

Haplophragmium cassis (Parker), rare.
Verneuilina polystropha (Rss.), rare.
Polymorphina, sp., a fragment.
Discorbina rosacea (d'Orb.), one specimen.
Pulvinulina punctulata (d'Orb.), very rare.
Nonionina depressula (W. & J.), very common.
Polystomella Sibirica, Göes, very rare.
P. striato-punctata (F. & M.), frequent.

Sponge spicules, common.

4. "BELUGA BAY, South Gooseland, 8 fathoms, July 24, 1897."

FORAMINIFERA.

Reophax scorpiurus, Montf., a broken specimen.
Haplophragmium, sp., rare.
Verneuilina polystropha (Rss.), very common.
Cassidulina crassa, d'Orb., very rare.
Lagena marginata (W. & B.), one specimen.
Pulvinulina punctulata (d'Orb.), rare.
Nonionina depressula (W. & J.), rare.
N. stelligera, d'Orb., one specimen.
Polystomella striato-punctata (F. & M.), one specimen.

Sponge spicules, rare.

75 specimens of *Verneuilina polystropha* occurred in this gathering, whilst the other species numbered in all only 19.

List of Localities of the Pleistocene Foraminifera, with Particulars of their Relative Abundance, &c.

Localities.	Relative Abundance of Foraminifera, with Number of Specimens from each Locality.	Quantities of Material Examined.	Quantities of Material after being Washed, and with coarse Stuff removed.
		Oz. Troy.	Oz. Troy.
1. West side of Dolga Bay, Waigats Island	Foraminifera, plentiful, 85 specimens	1.3	0.2
2. Starvation Bay, Waigats Island, Dolga Bay	„ very rare, 5 specimens	5.9	1.63
3. Waigats Island, Dolga Bay	„ very rare, 2 specimens	0.8	0.2
4. „ „	„ rare, 22 specimens	1.21	0.15
5. South end of Waigats Island	„ very rare, 5 specimens	3.2	0.65
6. Habarova, Yugor Straits, Russian mainland	„ very rare, 4 specimens	0.9	0.2
7. „ „ „	„ in great profusion, 411 specimens	0.83	0.37
8. Cape Matinsela, east side of Waigats Island	„ extremely rare, 2 specimens	5.9	2.25
9. East side of Beluga Bay, Matyushin Shar	„ very rare, 4 specimens	2.5	1.18
10. Beluga Bay, Matyushin Shar, North Island, Novaya Zemlya	„ in great profusion, estimated 900 specimens	8.0	2.22
11. East side, Beluga Bay, Matyushin Shar	„ very rare, 4 specimens	1.26	0.18
12. „ „ „	„ very rare, 2 specimens	1.92	0.32
13. South side, Matyushin Shar	„ in great profusion, estimated 330 specimens	0.73	0.13
14. Beluga Bay, 3 miles inland	„ in great profusion, estimated 640 specimens	2.3	0.4
15. Nameless Bay, on Besemennaya Bay, West Coast of Novaya Zemlya proper	„ in great profusion, 351 specimens	1.7	0.16

List of Localities of the Shallow-Water Foraminifera, with Particulars of their Relative Abundance, &c.

Localities.	Relative Abundance of Foraminifera, with Number of Specimens from each Locality.	Quantities of Material Examined.	Quantities of Material after being Washed, and with coarse Stuff removed.
		Oz. Troy.	Oz. Troy.
1. Dolga Bay, Waigats Island, 4½ fathoms	Foraminifera, rare, 27 specimens	1.35	0.28
2. Straits of Yugor, 4½ fathoms	„ plentiful, 154 specimens	1.55	0.61
3. 10 miles west of Belkofski Nos, 8 fathoms	„ rare, 53 specimens	0.79	0.313
4. Beluga Bay, S. Gooseland, 8 fathoms	„ rare, 94 specimens	1.25	0.85

Note.—The quantities of material given in the last column of each list was what remained in a sieve of miller's silk, 150 meshes to the inch, after washing; the coarse material retained in a sieve of 19 meshes to the inch having been removed.

TABLE II.—DISTRIBUTION OF THE FORAMINIFERA IN THE PLEISTOCENE CLAYS OF NOVAYA ZEMLYA AND ADJOINING MAINLAND OF RUSSIA.

ABBREVIATIONS :—*vr*, very rare ; *r*, rare ; *f*, frequent ; *c*, common ; *vc*, very common.

GENERA AND SPECIES.	West side of Dolga Bay, Waigats Island.	Starvation Bay, Waigats Island.	Waigats Island, Dolga Bay.	Waigats Island, Dolga Bay.	South end of Waigats Island.	Habarova, Yugor St., Russian Mainland.	Habarova, Yugor St., Russian Mainland.	Cape Matinsela, E. side of Waigats Island.	East side of Beluga Bay, Matyushin Shar.	Beluga Bay, North Island, Novaya Zemlya.	East side of Beluga Bay, Matyushin Shar.	East side of Beluga Bay, Matyushin Shar.	South side of Matyushin Shar.	Beluga Bay, North Island, Novaya Zemlya, 3 miles Inland.	Nameless Bay, or Besemennaya Bay, Novaya Zemlya proper.
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Miliolina seminulum (Linn.)	...	*vr*	*vr*	...	...	...	...	*vr*	...	*f*	...	...	...	*c*	...
M. tenuis (Cz.)	...	...	...	...	...	...	...	...	...	...	...	...	...	*vr*	...
Bulimina pupoides, d'Orb.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	*vr*
Virgulina Schreibersiana, Cz.	...	...	...	...	...	...	*vr*	...	...	...	...	...	*vr*	*vr*	*r*
Bolivina plicata, d'Orb.	...	...	...	...	...	...	...	...	...	...	...	...	...	*c*	...
Cassidulina lævigata, d'Orb.	*f*	...	...	*r*	...	*vr*	*r*	...	*vr*	*vc*	...	...	*vc*	*vc*	*vc*
C. crassa, d'Orb.	*f*	...	...	*vr*	*vr*	*vr*	*vc*	...	...	*vc*	...	...	*vc*	*vc*	*vc*
Lagena globosa (Montg.)	...	...	...	...	...	...	...	...	...	*vr*	...	...	...	*f*	...
L. lævis (Montg.)	...	...	...	...	...	...	*vr*	...	...	...	...	...	...	*vr*	...
L. acuticosta, Rss.	...	...	...	...	...	...	...	...	...	*vr*	...	...	...	...	...
L. sulcata (W. & J.)	...	...	...	...	...	...	...	...	...	...	...	...	...	*f*	...
L. Williamsoni (Alcock)	...	...	...	...	...	...	...	...	...	*vr*	...	...	...	*r*	...
L. striato-punctata, P. & J.	...	...	...	...	...	...	...	...	...	*vr*	...	...	...	...	...
L. distoma, P. & J.	...	...	...	...	...	...	...	...	...	...	...	...	...	*vr*	...
L. squamosa (Montg.)	...	...	...	...	...	...	*vr*	...	...	*f*	...	...	*vr*	*vc*	...

L. lævigata (Rss.)	...	...	...	...	...	...	...	...	...	*vr*	...	...	...	*vr*	...
L. marginata (W. & B.)	...	...	...	...	...	...	...	...	*vr*	*r*	...	...	...	*vc*	...
Nodosaria pauperata, d'Orb.	*vr*	...	...	*vr*	...	...	...	...	...	*vr*	...	...	...	*vr*	...
N. calomorpha, Rss.	...	...	...	...	...	...	...	...	...	...	...	...	...	*vr*	...
Cristellaria crepidula **(F. & M.)**	...	...	...	...	...	...	*vr*	...	...	*vr*	...	...	...	...	...
Polymorphina lanceolata, **Rss.**	...	...	...	...	...	...	...	...	...	...	...	...	...	*r*	...
P. rotundata **(Born.)?**	...	...	...	...	...	...	*vr*	...	...	...	...	...	...	...	...
Uvigerina canariense, d'Orb.	...	...	...	*vr*	...	...	...	...	...	...	...	...	...	*vr*	...
U. angulosa, Will.	*vr*	...	...	...	...	...	...	...	...	...	...	...	*vr*	*vr*	*vr*
U. pygmæa, d'Orb.	...	...	...	...	...	...	...	...	...	...	...	...	...	*vr*	...
Patellina corrugata, Will.	...	...	...	...	...	...	...	...	...	...	...	...	...	*vr*	...
Globigerina bulloides, d'Orb.	...	...	...	...	...	...	...	...	...	...	...	...	...	*r*	...
Pullenia quinqueloba, Rss.	*vr*	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Discorbina globularis (d'Orb.)	...	...	...	...	...	...	...	...	...	*f*	...	...	...	*c*	...
D. Wrightii, Brady ?	...	...	...	...	...	...	...	...	...	*vr*	...	...	...	...	...
Truncatulina refulgens (Montf.)	*r*	...	...	...	*vr*	*vr*	...	...	...	*vc*	*r*	...	*r*	*vc*	*f*
T. lobatula (W. & J.)	*c*	...	...	*vr*	*vr*	...	*f*	...	*vr*	*vc*	*vr*	*vr*	*vc*	*vc*	*vc*
T. ungeriana (d'Orb.)	...	...	...	...	...	...	...	...	...	...	...	...	...	*vr*	...
Pulvinulina Karsteni (Rss.)	*vr*	...	...	...	...	...	*f*	...	...	*r*	...	...	*f*	*vc*	*vc*
P. punctulata (d'Orb.)?	*vr*	...	...	...	...	...	...	...	...	*r*	...	...	...	...	...
Nonionina depressula (W. & J.)	*vc*	*r*	*vr*	*f*	*vr*	...	*vc*	*vr*	...	*vc*	...	...	*c*	*vc*	*vc*
N. umbilicatula (Montf.)	...	...	...	*r*	...	...	...	...	...	*f*	...	...	...	*c*	...
N. turgida, Will.	...	...	...	...	...	...	...	...	...	*vr*	...	...	*vr*	*r*	...
N. scapha (F. & M.)	*vr*	...	...	...	...	...	...	...	...	...	...	...	*r*	*f*	*f*
N. stelligera, **d'Orb.**	*vr*	...	...	...	...	...	*vr*	...	...	*r*	...	...	*r*	*c*	*f*
Polystomella subnodosa **(Münst.)**	...	...	...	...	...	...	...	...	...	...	...	...	*vr*	...	...
P. crispa **(Linn.)**	...	...	...	...	...	...	...	...	...	*vr*	...	...	...	...	...
P. striato-punctata **(F. & M.)**	*r*	...	...	*vr*	...	*vr*	*vc*	...	...	*vc*	...	...	*c*	*vc*	*vc*
P. arctica, **P. & J.**	*r*	*vr*	...	*vr*	...	...	*vr*	...	...	...	...	...	...	*vr*	*r*

Table III.—Distribution of the Shallow-Water Foraminifera off the South Coast of Novaya Zemlya.

Abbreviations :—*vr*, very rare ; *r*, rare ; *f*, frequent ; *c*, common ; *vc*, very common.

Genera and Species.	Dolga Bay, Waigats Is., 4½ fathoms. 1	Straits of Yugor, 4½ fathoms. 2	10 Miles W. of Belkofski Nos, 8 fathoms. 3	Beluga Bay, 8 fathoms. 4
Miliolina subrotunda (Montg.)	...	*vr*	...	...
M. seminulum (Linn.)	...	*vr*	...	...
Reophax scorpiurus, Montf.	...	...	...	*vr*
Haplophragmium cassis (Parker)	...	...	*r*	...
" *sp.*	*f*	...	...	*r*
Verneuilina polystropha (Rss.)	*f*	...	*r*	*vc*
Cassidulina crassa, d'Orb.	...	...	...	*vr*
Lagena marginata (W. & B.)	...	...	...	*vr*
Polymorphina rotundata (Born.)	...	*vr*	...	...
Discorbina rosacea (d'Orb.)	...	...	*vr*	...
Pulvinulina Karsteni (Rss.)	...	*vr*	...	...
P. punctulata (d'Orb.)	...	*f*	*vr*	*r*
Nonionina depressula (W. & J.)	*vr*	*vc*	*vc*	*r*
N. stelligera, d'Orb.	...	...	...	*vr*
Polystomella Sibirica, Göes	...	...	*vr*	...
P. striato-punctata (F. & M.)	*r*	*f*	*r*	*vr*

APPENDIX G

ORNITHOLOGY.

THE following notes are a brief summary of our observation on the Bird-life of the regions we visited in 1895 and 1897, and are given to afford an easier reference to the principal facts recorded in the previous pages. Fuller details will be found in most instances by reference to the Index.

Turdus iliacus.—The Redwing was fairly numerous in Russian Lapland, especially about Lake Ukanskoe.

Turdus torquatus.—Several Ring-Ouzels were seen near our camp in Russian Lapland.

Saxicola œnanthe.—The Wheatear was twice seen in Russian Lapland. We did not meet with it on Kolguev, and only one was seen there by Mr. Trevor-Battye. It was recorded for the first time on Waïgatch by us, namely, at Dolgaja Bay, July 8th, 1897, and at Cape Matinsela, July 18th.

Cyanecula suecica.—A nest of the Red-spotted Blue-throat was taken in Russian Lapland on June 26th, with seven eggs.

Phylloscopus trochilus.—The Willow-Warbler was abundant in Russian Lapland. Five or six eggs were usually a clutch, but two nests contained seven.

Acrocephalus phragmitis.—A Sedge-Warbler was shot near Lake Ukanskoe, and two others seen there.

Cinclus, sp. in.—A Dipper was seen on the Ukanskoe River, but not near enough for the determination of the species.

Motacilla alba.—Several White Wagtails were seen near the coast of Sviatonoskaia Bay, Russian Lapland, and a nest of six eggs was found inland, June 24th, 1895. The species was also met with on Kolguev, and several were seen there by Mr. Trevor-Battye. A male was shot at Habarova, July 17th, 1897, and another seen the same afternoon.

Anthus pratensis.—We found the Meadow-Pipit a common species in Russian Lapland, especially on the higher ground. The nest is usually placed in a drier position than that of the following species. We did not meet with this bird to the east of Lapland. Mr. Trevor-Battye saw a flock on Kolguev, August 15th, but found none breeding there. It is not recorded by previous writers on Novaya Zemlya.

Anthus cervinus.—The Red-throated Pipit was locally common in Russian Lapland, especially round the tarns and more marshy ground, where it took the place of the Meadow-Pipit. On Kolguev four nests were found between July 5th and 15th, two with eggs nearly fresh, one with eggs much incubated, and one with young. This was a common species on Waïgatch, and nine clutches of eggs were taken between July 3rd and 11th, most of them much incubated. Further notes on the eggs are given under date July 8th. On Dolgoi Island these Pipits were numerous; the young were on the wing July 20th. Several birds were seen in the south of Novaya Zemlya in 1895, but none in 1897. The nest of this species is usually placed on the side of a hummock in swampy ground, and is well concealed. A full clutch numbers from four to six eggs, but in one case seven were found. The eggs often vary greatly in colour in a nest, and are frequently blotched and marked with rich maroon tints, from the palest shades to nearly black.

Linota linaria.—A young male of the Mealy Redpoll was shot July 6th, 1895, near the Gobista River, Kolguev, the first record of this bird on that island. We found a nest of this species with three eggs (fresh) near Habarova, July 14th, 1897, and shot the male. Several Linnets were seen on Waïgatch which I believe belonged to this species.

Linota exilipes.—On Russian Lapland Coues's Redpoll was the only one seen. It was abundant on both sides of the fjord and round Lake Ukanskoe. Pairs were also scattered over the hills as high as the birch reached. Five nests contained four or five eggs each, much incubated, and six young. Both eggs and nests are indistinguishable from those of *L. linaria.*

Calcarius lapponicus.—The Lapland Bunting was scarce in Russian Lapland. On Kolguev it was one of the most abundant of the small birds, and by July 15th family parties were near the coast preparing for migration. This species was somewhat local on Waïgatch, and never numerous. We met with it chiefly on the west side of Dolgaja Bay, where the tundra resembled that of Kolguev. A few were seen near Cape Greben on July 15th. We also met with these Buntings near Habarova and on Dolgoi Island. Several were seen in the south of Novaya Zemlya in 1895, but none in 1897.

Plectrophenax nivalis.—The Snow-Bunting was not met with in Russian Lapland. On Kolguev it was common, and nests of young birds were found there on July 5th, 1895, while by the 15th many young birds were on the wing. The nests were chiefly in fissures at the edges of the bluffs, and were made of grasses, lined with a few white feathers of the Willow-Grouse. On Waïgatch this was the commonest bird in all parts visited; young were on the wing

June 29th, 1897, and several very abnormal nests are recorded on July 2nd and 3rd of that year. This species was seen on Dolgoi Island and on the mainland near Habarova. At all the places visited in Novaya Zemlya and Lütke Land it was more plentiful than any other land-bird. On July 24th, 1895, two nests were found with fresh eggs. In 1897 the birds were in flocks preparing for departure before August 6th.

Corvus corax.—Several Ravens were seen in Russian Lapland near the coast.

Otocorys alpestris.—The Shore-Lark was fairly common in Russian Lapland, and still more numerous on Kolguev. On Waïgatch it was plentiful wherever we landed; and some were seen on Dolgoi Island. We saw it at most of the places visited in Novaya Zemlya, but not in the numbers we had found it on Waïgatch. A few were noticed in the south parts of Lütke Land. From this it appears that Waïgatch is on the northern boundary of the main breeding-area of the Shore-Lark, and that those in Novaya Zemlya may be looked upon rather in the light of stragglers. The favourite position for the nest is in the side of a dried tussock of coarse grass on the tundra, the upper edge of the nest being level with the surface of the ground. The outer part is made of fine grasses, and the inner lining of the fluffy down of the willow, bog-cotton, and *Nardosmia frigida.* A full clutch of eggs varies from four to five. The bird at times sits very close, and will allow you to approach within two yards.

Nyctea scandiaca.—We only saw one Snowy Owl on Kolguev, and Mr. Trevor-Battye believes that it does not breed there. Several were seen on Waïgatch. On Novaya Zemlya we saw six or eight; in 1895 and 1897 they were met with wherever we landed, both there and in Lütke Land, and the Samoyeds at Belootchia Bay, South Novaya Zemlya, say this bird usually nests there in May. A dead bird was picked up on Dolgoi Island. I have never yet had the good fortune to find the eggs or young, as 1895 and 1897 were bad Lemming years, but many old nests were seen. The nest is a hollow some twenty inches across, placed on the top of a mound, from which the bird can obtain a good view in all directions.

Archibuteo lagopus.—The Rough-legged Buzzard is common in that part of Russian Lapland we visited, as nine nests were found there, June 20th–27th. This species was one of those we added to the list for Waïgatch, and three nests were found near Dolgaja Bay.

Haliaëtus albicilla.—A White-tailed Eagle was seen on the Nechwatowa River in Novaya Zemlya in 1895; and in 1897 one passed close to us at the head of Dolgaja Bay, Waïgatch. Dr. Thèel recorded this species near Cape Greben.

Hierofalco gyrfalco.—A pair of Gyr-Falcons were found nesting in a ravine on Russian Lapland.

Falco peregrinus.—We found the Peregrine breeding at Dolgaja Bay, Waïgatch, June 29, 1897; the nest contained three eggs. On July 18th a nest with three young in down was taken at Cape Matinsela on the east coast of Waïgatch; and on August 10th two old birds with four young just able to fly were seen on the cliffs of Silver Bay, Lütke Land. We completed the record of this species for the three islands by finding both old and young at Nameless Bay on August 11th.

Falco æsalon.—A Merlin was seen near Habarova on July 17th, 1897. This species had already been recorded there by Mr. H. L. Popham in the *Ibis*, 1897, p. 94. It had also been seen on the Petchora by Messrs. Harvie-Brown and Seebohm in 1875. I have recorded it, and also the White Wagtail, in the Porsangerfiord;[1] but although the latitude of this place is nearly the same as Habarova, its temperature is so much milder that the two can scarcely be compared from the point of Arctic distribution.

Phalacrocorax graculus.—Several Shags were seen round the islands of Russian Lapland.

Anser segetum.—A Bean-Goose was shot in Russian Lapland, June 26th, 1895, and some of its goslings caught. The Grey Geese seen on Kolguev no doubt belonged to this species, as Mr. Trevor-Battye states it is the Grey Goose of the island. Although none were shot on Waïgatch, we saw one flock well through our glasses, and identified them as Bean-Geese. On July 20th, 1895, three were shot near Nechwatowa Lake, Novaya Zemlya; and in 1897 we shot nine at Belootchia Bay on July 23rd. The largest from the latter place measured 31 inches from tip of beak to end of tail, and the shortest 27 inches. We also shot eight Bean-Geese near Belushja Bay, Lütke Land, August 2nd.

Anser albifrons.—A White-fronted Goose was shot at Belootchia Bay, July 24, 1895, out of a party of five; and twenty-seven were obtained at the same place, July 23rd, 1897. The longest was 28 inches, and the shortest 25 inches from tip of beak to end of tail. Five of this species were seen in Belushja Bay, Lütke Land, July 28th. We did not meet with the Brent-Goose either in 1895 or 1897, although it has been recorded by almost all previous writers.

Cygnus bewicki.—A Bewick's Swan and four young in down were obtained near the Gobista River on Kolguev, July 9th, 1895. The young had: Iris, bluish-brown; tip of bill, pearl-grey shading into blue before nares; point of under mandible, bluish-grey; base of lower mandible, pinkish-white. Their legs and feet were pinky-white, nails bluish-grey. Eight of this species passed within 100 yards of us in Dolgaja Bay, Waïgatch, July 3rd, 1897. Four were seen at Belootchia Bay in 1895, but none in 1897 in any part of Novaya Zemlya.

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[1] The *Ibis*, April 1894.

Fuligula marila.—A pair of Scaups were seen and the male shot in Russian Lapland.

Harelda glacialis.—Long-tailed Ducks were common in Russian Lapland. They were also numerous about the Gobista River on Kolguev, where they appear to breed on the tundra at some distance from water. Large flocks of fifty to seventy were constantly seen both on Waïgatch and Novaya Zemlya. The flesh of this Duck is best avoided as long as other food can be obtained. The average number of eggs in a clutch is six to nine.

Somateria mollissima.—The Common Eider-Duck is not so numerous in Russian Lapland as in Norway, nor is it likely to be, as the natives take every nest they can find, and shoot every Duck. Neither we nor Mr. Trevor-Battye met with this species on Kolguev; but it is fairly plentiful on Waïgatch and Novaya Zemlya, and breeds on the islands round the coast. The female delays making her nest until the ice has left the shore, doubtless partly because there is then less danger of her being disturbed by foxes. In 1895 many nests were only just commenced on July 25th, whereas in 1897 most of the Ducks had their young with them on the sea in the same district, July 27th. Both this and the following species are good for the table, if the skin is not eaten.

Somateria spectabilis.—The King-Eider is common on Kolguev. The only nest found was one on the tundra, from which the young had been recently hatched; it was more than a mile from the river and three from the sea. This species is also the Eider of Dolgoi Island; we shot a young bird in down with its mother on July 20th. On Novaya Zemlya and Lütke Land the King-Eider is numerous. In 1895 we saw nearly 200 males in one flock at the western entrance of Kostin Shar, and met with very large flocks in Matyushin Shar in 1897. No authentic eggs were found in either year.

The published coloured illustrations of the head of this bird are not quite correct. We made the following notes as soon as the birds got on board: "Iris, black; wattle, bright yellow-orange; nail on upper mandible, shape and colour of an ordinary finger-nail; culmen, light purple-grey, toning into orange-red at base."

Mergus merganser.—Two pairs of the Goosander were seen in Russian Lapland, and several on Kolguev in 1895; while in the same year we saw some Ducks on Novaya Zemlya which we thought belonged to this species. As two were shot at Cape Matinsela, Waïgatch, on July 18th, 1897, the above opinion was confirmed to some extent. This bird had not previously been found on Waïgatch, or Novaya Zemlya.

Mergus serrator.—Several Red-breasted Mergansers were seen on Waïgatch, also near Habarova. We shot two of this species near Belushja Bay, Lütke Land, on August 2nd.

Lagopus albus.—The Willow-Grouse was fairly common in Russian Lapland and on Kolguev. The only nest found on the latter island contained fourteen eggs, the largest clutch I have seen of this species. We found no trace of Willow-Grouse or Ptarmigan on Waïgatch, nor on Novaya Zemlya; it is true that some previous writers include them in their list, but I cannot find that specimens have been shot. I believe the Karataikha River to be the northern boundary of *Lagopus albus* in this part of the world.

Charadrius pluvialis.—Golden Plover were fairly common in Russian Lapland, but we met with none on Kolguev, and Mr. Trevor-Battye only saw one there. Five were seen near Dolgaja Bay, Waïgatch, on July 2nd, 1897, and several near Cape Greben, July 11th.

Squatarola helvetica.—The Grey Plover was constantly seen in those parts of Kolguev we visited in 1895. Accounts of its nesting habits will be found in Chapter II. We took seven clutches of eggs and several young between July 7th and 13th. This species was met with on Dolgoi Island, July 20th, 1897, when the young were on the wing, both old and young being very wild.

Ægialitis hiaticola.—The Ringed Plover is a bird very generally distributed in the Arctic region, and we found it in every place visited from Lapland to Lütke Land.

Eudromias morinellus.—Two nests of the Dotterel were taken in Russian Lapland, June 20th, 1895. This species was commoner on Waïgatch than in any other country I have visited. We found four nests there between June 29th and July 18th, 1897. One female was shot from the nest, but three shot with the young were males. Several Dotterel were shot on Dolgoi Island, and a few seen at Habarova. We shot a very beautiful light-coloured female near the Nechwatowa River, July 22nd, 1895, and on the 24th took a clutch of three eggs on an island at the head of Belootchia Bay, the bird shot from the nest being a male. None of this species were seen in Novaya Zemlya in 1897.

Strepsilas interpres.—Two or three pairs of Turnstones were seen on the islands off Russian Lapland. On Kolguev the birds were in about equal numbers with the Grey Plover, and bred near them on the tundra. Turnstones are very noisy when their young are approached, and resort to devices similar to those of the Plovers to lure intruders away. We were surprised not to find this bird on Waïgatch, as the country appeared suitable for it. Both old and young were shot on Dolgoi Island, also an old one at Habarova on July 16th. In 1895 we shot old birds and took young in down on South Gooseland, but saw none in Novaya Zemlya in 1897. Dr. Thèel observed several near North Goose Cape in 1875.

Hæmatopus ostralegus.—Oyster-catchers were seen on one island off Russian Lapland.

Phalaropus hyperboreus.—The Red-necked Phalarope was fairly numerous on Russian Lapland in suitable localities. A number of these birds were also seen on Kolguev. On Waïgatch in 1897 they were common in all the marshes, and eggs were found up to July 5th. The only bird shot from the nest was a male. The species was common on Dolgoi Island. We did not meet with it in Novaya Zemlya.

Phalaropus fulicarius.—Mr. W. S. Bruce has recently added the Grey Phalarope to the Novaya Zemlya list. He shot a pair on June 19th, 1898, at Kostin Point, the south end of Meshdoshapsk Island. Although he felt sure they were breeding there, a long search failed to reveal the nest.

Gallinago major.—Four eggs of the Great Snipe were taken near Lake Ukanskoe, Russian Lapland.

Tringa alpina.—The Dunlin was common in the more marshy parts of Kolguev visited. It was sparsely but evenly distributed over all the parts of Waïgatch we explored, the birds usually having young, but a clutch of four eggs, half incubated, was taken on July 8th. A bird of the year was shot at Habarova on July 17th; and several pairs of old birds were seen on Dolgoi Island. Dr. Thèel recorded this species in Goose Land, Novaya Zemlya, but we did not meet with it in that country.

Tringa minuta.—A pair of Little Stints were shot in Russian Lapland when we first landed, but they did not appear to be breeding. On Kolguev these birds were fairly numerous on both sides of the Gobista River as far as it was affected by the tide, but there were no nests beyond that point. Little Stints ranked next the Snow-Buntings in numbers on Waïgatch, and did not confine themselves to the neighbourhood of salt-water there, as we found them breeding some miles inland. This species was also nesting at Habarova, on Dolgoi Island, and at Belootchia Bay. Von Heuglin states (*Ibis*, 1872, p. 63) that it breeds near Matuyshin Shar, and Dr. Thèel observed it on North Goose Cape.

Tringa temmincki.—Temminck's Stints were fairly plentiful in Russian Lapland, both round the village of Lutni and on the islands in Lake Ukanskoe. A number of eggs, found about June 24, 1895, were nearly fresh, and of three birds shot from the nest two were males. On Kolguev this bird was not nearly so common as the Little Stint. We added the species to the Waïgatch list by securing a male and four young in down in Dolgaja Bay on July 6th. Both old and young were also obtained near Cape Greben. At Habarova again, we found an old bird with four young; but the species is rare in the above countries, as only six or eight were seen in 1897.

Tringa striata.—We did not meet with the Purple Sandpiper in either Russian Lapland or Kolguev, although Mr. Trevor-Battye records examples from the latter place. During our visit to Novaya Zemlya in 1895 a few were seen in all those parts where we landed, and several appeared to be breeding. In 1897 they were observed everywhere except on Dolgoi Island. Young in down were obtained on Waïgatch, July 4th, 11th, and 15th; and a nest of four eggs was taken at Cape Greben, July 11th, the male being shot from the nest. Dr. Thèel states that this species nests near the shore and tarns on Waïgatch and Novaya Zemlya.

Machetes pugnax.—Several Reeves were shot on Waïgatch, and a number of both Ruffs and Reeves seen there. We only found two nests—one on June 30th with one egg, and one on July 4th with three. A young in down was obtained near Habarova, July 14th, and some Reeves were shot on Dolgoi Island. The above is the first record of this bird on Waïgatch.

Totanus glareola.—Some twenty Wood-Sandpipers were seen about Lake Ukanskoe. In a female we shot, the eggs were only beginning to pass down the oviduct, so the species appears to be a late breeder.

Totanus calidris.—Two pairs of Redshanks were seen, and one clutch of incubated eggs taken in Russian Lapland.

Sterna macrura.—The Arctic Terns were breeding in a large colony on one of the islands off Russian Lapland. A few of these birds were seen off the west coast of Kolguev, but—like Mr. Trevor-Battye—we never met with them on land there. We saw them off the west coast of Novaya Zemlya in 1895. The only occasion on which we found this species breeding in 1897 was on August 6th, at Pachtussoff Island, on the east coast of Lütke Land.

Pagophila eburnea.—We saw a number of Ivory Gulls in Bear Bay on the east coast of Lütke Land on August 8th, 1897. Among the birds shot were two males with large incubation spots.

Rissa tridactyla.—The Kittiwake was common in all the "Bird-Rocks" of Novaya Zemlya.

Larus glaucus.—Two or three pairs of the Glaucous Gull were usually about the mouth of the Gobista River on Kolguev. We shot a male and took a nest with two eggs on July 6th, 1895. A few scattered pairs breed on Waïgatch; we secured a family of two old birds and three young in down in Dolgaja Bay on July 2nd. We also found the species at Habarova, on Dolgoi Island, at all the places visited on Novaya Zemlya, and on Lütke Land as far as Pachtussoff Island; but the numbers at Nameless Bay exceeded all the others together seen during the voyage. Owing to the abundant supply of food provided there by the Guillemots, the Glaucous had thriven and increased wonderfully. We met with repeated proofs in 1895 and 1897 that these birds constantly rear three young ones.

Larus canus.—The Common Gull was plentiful in Russian Lapland, but not seen elsewhere.

Larus marinus.—A few pairs were breeding in Russian Lapland. This species was not seen to the east of the White Sea.

Larus affinis.—Black-mantled Gulls were observed on Novaya Zemlya, Waïgatch, Dolgoi Island, and at Habarova, but none were shot in 1897. That shot on Kolguev in 1895 was the Siberian River-Gull.

Stercorarius pomatorhinus.—We saw Pomatorhine Skuas on Kolguev, Waïgatch, Novaya Zemlya, and Lütke Land, but no indication that they were breeding.

Stercorarius crepidatus.—Richardson's Skuas were common, and breeding on the islands and near the coast of Russian Lapland. These Skuas were constantly to be seen in parties of two to eight hunting over the tundra on Kolguev; but we found no nests there. In 1897 two males and a female were shot on Dolgoi Island, and one, a female, at Habarova; all had white breasts; the male had mated with a black female.

Stercorarius parasiticus.—Several Buffon's Skuas were seen in Russian Lapland, and two shot—both males. A nest was taken there on July 22nd. This species was seen on Waïgatch and at Habarova in 1897. Skuas of all three kinds were very numerous over Barents Sea both in 1895 and 1897.

Fulmarus glacialis.—Several Fulmars were seen in Sviatonoskaia Bay, Russian Lapland, in 1895; but in 1897 we only met with them at sea off the west coast of Novaya Zemlya and east coast of Lütke Land.

Colymbus adamsi.—We saw two White-billed Northern Divers on Novaya Zemlya in 1895, and two passed within thirty yards of our boat in Nameless Bay in 1897. I believe further investigation will show that this species, and not *C. glacialis*, occupies these waters.

Colymbus arcticus.—A pair of Black-throated Divers were seen and their eggs taken on June 26th, in Russian Lapland. We saw several pairs on Kolguev, and found two new nests, but no eggs had been laid by July 16th.

The birds were seen on both the north and south of Waïgatch in 1897, and a nest with two eggs obtained June 30th. They were common on Dolgoi Island. Several of this species were seen in Novaya Zemlya in 1895, but none in 1897.

Colymbus septentrionalis.—The Red-throated Diver was common in Russian Lapland, and a number of eggs were taken. It was also fairly numerous on Kolguev; we shot two, and obtained several eggs about July 6th. The bird was plentiful on Waïgatch and Dolgoi Islands, and several were seen in Novaya Zemlya. One was shot, with its two young in down, on Waïgatch, July 15th, and a similar family at Belushja Bay, July 28th; in both cases it was the male bird which stayed to protect the young. Two pairs were seen on Pachtussoff Island, August 6th, but there was no sign of nest or young.

Lomvia bruennichi.—Colonies of Brünnich's Guillemots breed in several parts of the west coast of Novaya Zemlya, but the settlement at Nameless Bay is by far the largest, and ranks as one of the most important in the Arctic regions. A fuller description of it will be found under August 11th. We saw no breeding-places of this species on Waïgatch nor on the east coast of Lütke Land.

Uria grylle.—The Black Guillemot was very abundant on Medviji Island, Russian Lapland; there were quite two thousand in the neighbouring sea, besides those on their eggs.

Uria mandti.—Mandt's Black Guillemots were shot in Dolgaja Bay and on Pachtussoff Island. A bird of the year was seen in Nameless Bay on August 12th.

Mergulus alle.—Little Auks were only seen in 1895, when we met with them on the edge of the ice off Goose Land.

In the following lists the abbreviations are :—

B. Von Baer.
G. George Gillett, *Ibis*, 1870, p. 303.
H. Th. von Heuglin, *Ibis*, 1872, p. 60.
Pelz. Von Pelzeln.
Th. Dr. Hjalmar Théel, "Ann. Sci. Nat. Sér. Zool." tom. iv. art. 6.
M. Admiral Markham, "A Polar Reconnaissance."
P. Pearson and Feilden.

List of the Birds of Waïgatch.

1. *Saxicola œnanthe*	...	...	P.
2. *Anthus cervinus*	H.	Th.	P.
3. *Linota linaria* (?)	...	...	P.
4. *Calcarius lapponicus*	...	Th.	P.
5. *Plectrophenax nivalis*	H.	Th.	P.
6. *Otocorys alpestris*	H.	Th.	P.
7. *Nyctea scandiaca*	H.	...	P.
8. *Archibuteo lagopus*	...	...	P.
9. *Haliaëtus albicilla*	...	Th.	P.
10. *Falco peregrinus*	...	...	P.
11. *Anser segetum*	...	...	P.
12. *Cygnus bewicki*	...	...	P.
13. *Mareca penelope*	H.		
14. *Harelda glacialis*	H.	Th.	P.
15. *Somateria mollissima*	H.	...	P.
16. *Œdemia nigra*	H.	...	P.
17. *Œ. fusca*	H.		
18. *Mergus merganser*	...	...	P.
19. *M. serrator*	H.	...	P.
20. *Charadrius pluvialis*	H.	Th.	P.
21. *Ægialitis hiaticola*	H.	...	P.
22. *Eudromias morinellus*	...	Th.	P.
23. *Phalaropus hyperboreus*	H.	Th.	P.
24. *Tringa alpina*	H.	Th.	P.
25. *T. minuta*	H.	Th.	P.
26. *T. temmincki*	...	...	P.
27. *T. striata*	H.	Th.	P.
28. *Machetes pugnax*	...	...	P.
29. *Calidris arenaria*	H.		
30. *Sterna macrura*	...	Th.	...
31. *Larus glaucus*	H.	Th.	P.
32. *L. affinis*	H.	Th.	P.
33. *Stercorarius pomatorhinus*	H.	...	P.
34. *S. parasiticus*	...	Th.	P.
35. *Colymbus glacialis ?* [*C. adamsi ?*]	H.		
36. *C. arcticus*	H.	...	P.
37. *C. septentrionalis*	...	...	P.
38. *Uria mandti*	...	Th.	P.

List of the Birds of the South Island of Novaya Zemlya

1. *Anthus cervinus*	...	...	...	...	...	P.
2. *Calcarius lapponicus*	...	...	...	...	...	P.
3. *Plectrophenax nivalis*	B.	H.	Pelz.	Th.	M.	P.
4. *Otocorys alpestris*	...	H.	...	Th.	M.	P.
5. *Nyctea scandiaca*	B.	...	Pelz.	Th.	M.	P.
6. *Haliaëtus albicilla*	B.	...	...	...	...	P.
7. *Falco peregrinus*	...	...	Pelz.	...	...	P.
8. *Anser segetum*	B.	H.	...	Th.	M.	P.
9. *A. albifrons*	...	...	...	...	...	P.
10. *Bernicla brenta*	B.	H.	Pelz.	Th.	M.	...
11. *Cygnus bewicki*	...	H.	...	Th.	...	P.
12. *Harelda glacialis*	B.	H.	Pelz.	Th.	...	P.
13. *Somateria mollissima*	B.	H.	Pelz.	Th.	...	P.
14. *S. spectabilis*	B.	H.	Pelz.	Th.	M.	P.
15. *Œdemia nigra*	...	H.				
16. *Œ. fusca*	...	H.				
17. *Mergus merganser*	...	...	...	...	...	P.
18. *M. serrator*	...	...	...	Th.	M.	P.
19. *Ægialitis hiaticola*	...	H.	...	Th.	...	P.
20. *Eudromias morinellus*	...	...	...	...	...	P.
21. *Strepsilas interpres*	B.	...	...	Th.	...	P.
22. *Phalaropus fulicarius* (Bru.)						
23. *Tringa alpina*	...	...	Pelz.	Th.		
24. *T. minuta*	...	H.	...	Th.	...	P.
25. *T. striata*	B.	H.	...	Th.	M.	P.
26. *Sterna macrura*	B.	H.	...	Th.	...	P.
27. *Pagophila eburnea*	B.	H.	Pelz.	Th.	M.	
28. *Rissa tridactyla*	B.	H.	...	Th.	...	P.
29. *Larus glaucus*	B.	H.	...	Th.	M.	P.
30. *L. canus*	B.					
31. *L. affinis ?*	...	...	Pelz.	...	...	P.
32. *Stercorarius catarrhactes*	B.					
33. *S. pomatorhinus*	...	H.	...	...	...	P.
34. *S. crepidatus*	...	...	...	Th.	M.	
35. *S. parasiticus*	...	H.	...	Th.	...	P.
36. *Fulmarus glacialis*	...	...	...	Th.	...	P.
37. *Colymbus glacialis ?*	...	...	...	...	M.	
38. *C. adamsi*	...	...	...	...	...	P.
39. *C. arcticus*	...	...	...	...	...	P.
40. *C. septentrionalis*	B.	...	Pelz.	Th.	...	P.
41. *Lomvia bruennichi*	B.	H.	Pelz.	Th.	M.	P.
42. *Uria mandti*	B.	H.	Pelz.	Th.	M.	P.
43. *Mergulus alle*	B.	...	Pelz.	Th.	M.	P.
44. *Fratercula glacialis*	B.	...	Pelz.	Th.		

List of the Birds of the North Island of Novaya Zemlya (Lütke Land).

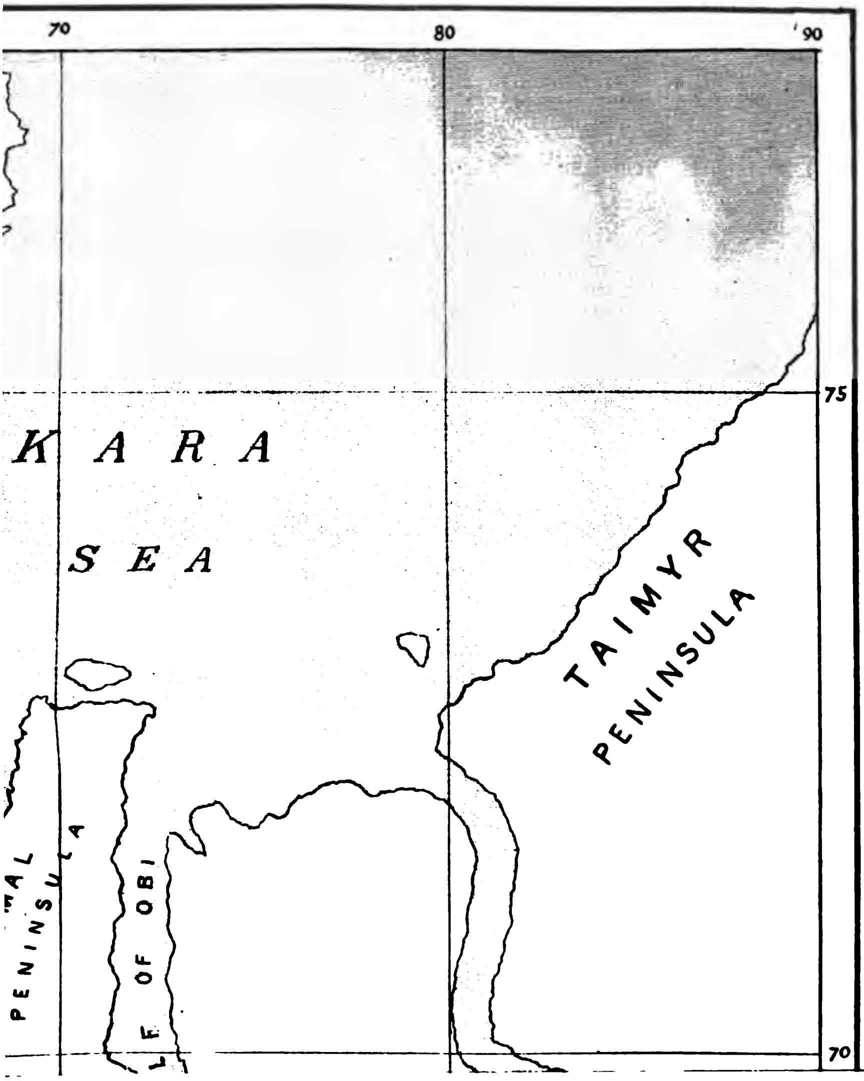
1. *Hirundo rustica*	G.			
2. *Plectrophenax nivalis*	G.	H.	M.	P.
3. *Otocorys alpestris*	...	...	M.	P.
4. *Nyctea scandiaca*	G.	H.	M.	P.
5. *Falco peregrinus*	G.	...	...	P.
6. *Anser segetum*	...	...	...	P.
7. *A. albifrons*	...	...	...	P.
8. *Bernicla brenta*	G.	...	M.	
9. *Harelda glacialis*	G.	H.	M.	P.
10. *Somateria mollissima*	G.	H.	M.	P.
11. *S. spectabilis*	G.	...	M.	P.
12. *Mergus serrator*	...	...	...	P.
13. *Charadrius pluvialis*	...	...	M.	
14. *Ægialitis hiaticola*	G.	H.	M.	P.
15. *Eudromias morinellus*	G.			
16. *Strepsilas interpres*	...	...	M.	
17. *Tringa striata*	G.	H.	M.	P.
18. *Sterna macrura*	G.	H.	M.	P.
19. *Pagophila eburnea*	G.	...	M.	P.
20. *Rissa tridactyla*	G.	...	M.	
21. *Larus glaucus*	...	...	M.	P.
22. *Stercorarius pomatorhinus*	G.	H.	M.	P.
23. *S. crepidatus*	G.	...	M.	
24. *S. parasiticus*	G.	H.	M.	
25. *Fulmarus glacialis*	G.	...	M.	P.
26. *Colymbus glacialis ?*	...	...	M.	
27. *C. arcticus*	...	...	M.	
28. *C. septentrionalis*	...	H.	M.	P.
29. *Lomvia bruennichi*	G.	...	M.	
30. *Uria mandti*	G.	...	M.	P.
31. *Mergulus alle*	G.	...	M.	
32. *Fratercula glacialis*	G.			

List of the Birds observed on Dolgoi Island, July 20, 1897.

1. *Anthus cervinus.*
2. *Calcarius lapponicus.*
3. *Plectrophenax nivalis.*
4. *Otocorys alpestris.*
5. *Nyctea scandiaca* (feathers only).
6. *Harelda glacialis.*
7. *Somateria spectabilis.*
8. *Squatarola helvetica.*
9. *Ægialitis hiaticola.*
10. *Eudromias morinellus.*
11. *Strepsilas interpres.*
12. *Phalaropus hyperboreus.*
13. *Tringa alpina.*
14. *T. minuta.*
15. *Machetes pugnax.*
16. *Larus glaucus.*
17. *L. affinis ?*
18. *Stercorarius crepidatus.*
19. *Colymbus arcticus.*
20. *C. septentrionalis.*

List of the Birds observed at Habarova, July 14 and 18, 1897

1. *Motacilla alba.*
2. *Anthus cervinus.*
3. *Linota linaria.*
4. *Calcarius lapponicus.*
5. *Plectrophenax nivalis.*
6. *Otocorys alpestris.*
7. *Nyctea scandiaca.*
8. *Falco æsalon.*
9. *Harelda glacialis.*
10. *Somateria*, species ?
11. *Mergus serrator.*
12. *Ægialitis hiaticola.*
13. *Eudromias morinellus.*
14. *Strepsilas interpres.*
15. *Tringa alpina.*
16. *T. minuta.*
17. *T. temmincki.*
18. *T. striata.*
19. *Machetes pugnax.*
20. *Larus glaucus.*
21. *L. affinis ?*
22. *Stercorarius crepidatus.*
23. *S. parasiticus.*
24. *Colymbus arcticus ?*
25. *C. septentrionalis.*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